JOURNAL

OF THE

FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

DEVOTED TO THE

MECHANIC ARTS, MANUFACTURES, GENERAL SCIENCE,

AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

JUNE, 1832.

Notes of an Observer.—*On the Expenditure of Mechanical Power.*

If the reader will turn to the number of this journal for March, p. 201, he will find an artiele extracted from the Register of Arts, containing, as I conceive, a very erroneous method of calculating the power expended in propelling a coach on a turnpike with different velocities.

It appeared, by a series of experiments made by Mr. Macneil, under the superintendence of Mr. Telford, on the London and Liverpool road, in which the force of traction was very accurately ascertained by means of an improved dynamometer, that this force constantly increased with an increasing velocity.

The writer who makes remarks on these experiments comes to the conclusion, that when the velocity is increased from six miles an hour to ten, "there is a saving of nearly one-third of the power expended in conveying a given load the same distance. For although it takes a greater power during the same space of time to draw it at a high than at a low velocity, the gain is in the increase of space passed over by a given power in a given time. No advantage can, however, be taken of this circumstance, with carriages drawn by horses, as horses can exert but little power of draught at high velocities; but in locomotive carriages the case is otherwise," &c.

Now if the power expended is to be calculated by the force of traction multiplied by the *time* in which a particular distance is passed over, the deductions of the writer in question would be correct; but this is not the fact. The force of traction must in all cases be mul-

tiplied into the *space* passed over, without regard to the time, when we wish to know the power expended. And where the force of traction is the same at all velocities, as it is on rail-roads, the power expended will be the same in going a given distance whatever the velocity may be.

The writer in question will undoubtedly agree with me that the power expended is in proportion to the quantity of coals used, or which is the same thing, the quantity of steam. Now if he will consider that in running on a rail-road, the force of traction—that is, the density of the steam, is the same at all velocities, he will easily perceive that the quantity of steam used in a given time, will be as the velocity, that is, a double velocity will expend double the quantity of steam, and a triple velocity, a triple quantity, &c. in the same time.

Therefore, *the quantity of steam used is as the space passed over without regard to time.*

If, however, the force of traction increases with the velocity, as in the experiments mentioned above, then the quantity of steam used in passing over a given space will increase with an increased velocity; consequently the power expended, that is, the quantity of steam used, will be greater with high velocities than low, in direct proportion to the force of traction.

I do not know whether any practical man could be led astray by the writer whose error is here corrected, but I thought it ought not to pass without notice.

In conclusion I observe that the views of Mr. Green, who furnished the experiments mentioned above for publication, appear to me to be correct, for he says they are communicated to the editor of the Repertory for the express purpose of correcting the error which almost universally prevails, that it requires less power to work a coach at a high than at a low velocity.

FRANKLIN INSTITUTE.

Explosions of Steam Boilers.

The subjoined communication has been received by the Committee on Explosions since the publication of the series terminating with No. XXVII, in vol. ix. No. 2, of this Journal.

(No. XXVIII.)

Letter from Thomas Ewbank, dated
New York, March 11, 1832.

Gentlemen,—The limited experience which I have in the subject to which your inquiries are directed, induces me to believe that all explosions of steam boilers, may be accounted for by the following causes: 1st. Defects in the construction of the boilers. 2nd. Excessive pressure of steam. 3d. Deficiency in the supply of water. 4th. Neglect. Several of these causes may sometimes combine to produce explosion.

1st. Boilers constructed with interior flues are defective from the nature of the construction, or from the form, situation, &c. of the flues. These, when made of the same material as the boiler, are, from their inferior diameter, almost infinitely stronger than the boiler can be; and ought certainly to be the last parts to give way. From the frequency of their rupture, it is evident that something about them is defective.

It may be said that the action of fire on their interior surface tends to wear them away; but they could only be affected by this cause in the same proportion as the bottom of boilers; this, therefore, does not account for the frequency of ruptures in them. Indeed, if flues are formed of copper and kept clean, with a sufficiency of water always above them, this action of the fire could not, in *many years*, essentially affect them. We see that a common copper tea kettle will last from twenty to fifty years in constant use, although the thickness of the metal, compared with that of a steam boiler, may be but as 1 to 12 or 15. The resistance of steam which flues have to endure, can hardly effect the *wear of the metal*, its tendency being rather to *strengthen* it by compression than otherwise. It has been suggested to discontinue altogether the use of interior flues, and thus cut off one great source of danger. There does not appear any very formidable objection to the adoption of this advice.

The danger arising from flues is considerable, not only on account of their proximity to the surface of the water, so that from a small deficiency, or the lurch of a boat, their upper surfaces become improperly heated, and their strength essentially impaired, but also from the fact of their expansion and contraction being unequal to those of the boiler in which they are placed.

When the *ratio* and *time* of expansion are not the same in both boiler and flues, (and it would be difficult to make them agree in these,) they then have a tendency to injure each other. Large boilers expand unequally, and necessarily so, their lower parts exposed to the fire, being kept at a much higher temperature than the upper parts. They also, from their superior capacity and the quantity of water over the parts exposed to the fire, probably expand more slowly than the flues, (this, however, will perhaps depend considerably on the kind of fuel used,) which latter, from their smaller surface, and the less quantity of water above them, together with the impinging of the flame against their sides in passing through them, are heated more readily. Flues are, besides, placed in that portion of a boiler which expands the least.

It matters not, however, whether the boiler or the flue expand soonest; the effect is the same so long as they do not expand *equally and in the same time*. The *amount* of expansion will of course vary with the material of which they are formed and its thickness. In some experiments which I made upon a wrought iron cylindrical boiler twenty feet long, two feet in diameter, and three-sixteenths of an inch thick, the length increased one line for every forty degrees of temperature: hence I conclude that a twenty feet iron flue, will, in

use, undergo an increase in length of from three-quarters of an inch to an inch, and a copper one still more.

If the ends of a boiler to which such a flue is attached, (and it expands more quickly than the boiler,) be made of cast iron, then either those ends must spring as the flue expands, or, the body of the boiler must be strained by the irresistible energy of this power. And should there be a weak or imperfect part in the boiler, it will find it out, and be exerted principally upon it.

When the ends of a boiler are of considerable extent, as those used in boats on the Hudson, and formed of wrought iron or copper, this unequal expansion of flues does little injury, because the ends yield readily to it, without always affecting the *same place* in the metal. But in smaller, or high pressure, boilers, with ends of wrought iron, as those used in the western waters, the effect of the flues is to protrude and draw in alternately those ends, the strain of the metal being almost always in the *same place*, and near their periphery; its action being similar to the bending a piece of metal backwards and forwards until it breaks.

When flues cool sooner than the boiler, the contraction is also exerted on the joints by which they are attached to it, which tends to start and cause them to leak. When parts of either boilers or flues are heated to redness through a deficiency of water, or other cause, their strength is diminished by the consequent expansion, as well as by a loss of tenacity from the heat.

Ruptures of flues are also influenced by the *materials* of which they are formed. When the top of a flue is not covered with water, the intense blast of flame passing through it, is capable of heating it to redness almost instantly, and consequently of destroying essentially its power of resistance. An *iron* flue under such circumstances, if not collapsed by the steam, would *not* have the *texture of the metal materially injured.* But the danger from a *copper* flue when thus heated is imminent, because whenever copper is heated to a bright red, or a little over the melting point of spelter solder, its tenacity is *completely destroyed, nor can it ever be recovered.* It becomes as brittle as spelter, and cannot be bent without breaking. This fact is well known to all coppersmiths; for in brazing, should the copper become "burnt," as it is technically termed, the burnt part must either be cut out, or the whole article thrown aside. The same effect, though in a less degree, is, I believe, caused by frequently heating copper to redness. Hence copper flues are more dangerous than those of iron, when exposed to fire unprotected by water, and new flues offer no more security from this evil than old ones. There was, therefore, no cause for surprise, when the flue of a new copper boiler was rent the first time it was used.

The flue of the "Chief Justice Marshall," I believe, was ruptured from this cause, and the appearance of the metal, (being full of irregular cracks all around the fracture,) indicated this. A diagram, representing the fracture, &c. with remarks, made soon after the accident, having been mislaid, I am unable to attach it to these observations.

When water once begins to subside below the flue of a steam-boat boiler, the enormous consumption of steam by the engine, rapidly reduces it; and should a supply of water be delayed for a few moments, the parts exposed, if of copper, would, in all probability, become "burnt," when the certainty of an explosion would be almost equal to that of the discharge of a musket, when the trigger is pulled. But if explosion, under such circumstances, did not take place *at that time*, the strength of the flue would be destroyed, the texture of the "burnt" part deranged, and its tenacity or ductility annihilated. To trust to a boiler with such a flue, is to "repose on a volcano." The same observations apply to the parts of copper *boilers* after being so exposed.

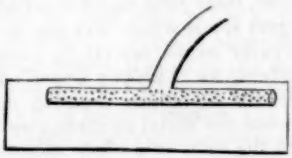
So long as the use of flues is continued, their *form* ought invariably to be cylindrical, this being the strongest shape which they can have. They are too frequently made in irregular ovals, merely to accommodate them to their position in boilers, as "kidney flues," &c. When the section of a flue is a circle, the steam, by pressing on it externally, tends to *strengthen* or *thicken* the metal by compression, in direct opposition to its influence on the interior surface of boilers when its tendency is to dilate or make the metal *thinner*. It would appear perfectly impossible for steam of any power to collapse a truly cylindrical flue; unless the strength of a part of it be first diminished or destroyed, as when exposed to fire uncovered by water.

Another defect in flues, as ordinarily used, is in their *situation*, being placed too *high*, or not having a sufficient depth of water over them. Few boilers are designed to have more than from three to six inches of water over the flues, while others have not more than one or two. In the boilers of stationary engines, three or four inches may suffice, if that depth be uniformly preserved; but in steam-boats where the level is constantly liable to considerable change, a greater depth ought certainly to be allowed, so that from six to eight inches of water should be over the flues, under all the ordinary changes of position of the boat. The situation of the boilers themselves, should, in some measure, regulate the depth of water required above the flues. When they are placed on the guards, their flues require more water over them than when placed in midship.

A further reason why flues should have a greater depth of water over them than is usually allowed, is to be found in the *repulsive power of heat*. The upper part of a flue is the hottest part, consequently the repelling power of that part is greater than that of any other; while at the same time, the least quantity of water is over it: thus the least resistance is opposed to this power where its energy is greatest. This repulsion produced by heat may readily be observed by dipping the point of a wire, (a knitting needle for example,) in the tallow of a candle, and collecting as much upon it as will form a drop; by moving the point into the flame, the heat will repel the tallow upwards, although held at an angle of forty-five degrees; and if continued in the flame, it may be brought to a vertical position, and yet the drop be prevented from falling down, which it will instantly do as the wire cools, when withdrawn from the flame. The same

principle is shown by Mr. Perkins, in making an aperture in the side of his generator, while at a red heat.*

The effect just explained is probably somewhat increased by the agitation produced within a boiler when steam is admitted to the cylinder. When steam is raised in a boiler, and the engine not working, the water within (if the flues are sufficiently covered,) is probably on a level and nearly at rest; but as soon as steam is admitted into the cylinder, it causes an ebullition of the water, which rises towards the mouth of the steam pipe, in consequence of a portion of the pressure upon it being *suddenly* removed at every stroke of the piston.



This might, I think, be prevented by continuing the steam pipe an inch or two into the boiler, and then branching it off towards each end of it, with small apertures in its sides and ends, as in the diagram.

In this manner, the steam would be equally withdrawn from every part of a boiler, instead of being violently agitated in rushing to one place. Such a tube attached to the aperture of a *safety valve*, would be equally advantageous; or the valve might be placed on one end of the tube leading to the cylinder. This tube might be made of very thin copper, as the pressure on it would be inconsiderable.

Again, a greater depth of the water over flues of steam-boat boilers should be allowed because the ordinary quantity is seldom sufficient to prevent danger after a defect in the means of supply is discovered. The attendant of an engine does not always know the precise moment when the water begins to fall below its proper level; he is only informed of it when he opens the gauge cock. Moreover, gauge cocks are not always certain criterions of the quantity of water in boilers, and even when they are, the supply pump does not always answer the demand of the gauge cocks; a circumstance often unknown to the engineer until the cocks, at some time after the first deficiency is seen, have confirmed a further deficiency, instead of indicating the anticipated supply.

Boilers in steam-boats necessarily partake of the motion of the boats, which renders it difficult to preserve the water at a uniform level; and although a sufficient quantity may be in them when on a level, yet, from their motion, part of the flues will be exposed, unless the supply be sufficient to cover them in the new position.

I would therefore suggest that boilers of boats should be constructed *without internal flues*, as one great preventive of explosions; and that so long as they are used, those boats which have but one or two large boilers, should have at least twelve inches of water over their flues, *when on a level*, the *lowest* gauge cock being that distance above their upper surfaces, and that the form of the flue should be cylindrical.

* See Franklin Journal vol. iii. p. 413, 421. 1827.

Gauge cocks over *each* flue, would also be advantageous, that when the flue on one side of a boiler is depressed by the lurching of a boat, it may be known whether those on the other side are covered by water or not.

2nd. Excess of steam.—It is obvious that this is one of the principal causes of explosions. Against it no boiler can of itself be secure, however strong its materials and unexceptionable its workmanship. Although it is not always the primary cause of explosions, yet it is almost always the active or direct one. When a deficiency of water is the first cause, an excess of steam is frequently created by the exposed part of either boiler or flues being suddenly brought in contact with the water; the consequent rapid accumulation of steam rends the boiler. The escape of the steam by the safety valve in such cases is out of the question, as it is generally loaded far beyond the proper weight, and the amount of that load perfectly unknown; hence no way of escape is left, unless by the gauge, where it is as effectually stopt, since the column of mercury opposed to it, when pressed into one arm of the gauge, would probably exceed the pressure necessary to rend the boiler. Besides, its capacity for such a purpose would be perfectly insignificant.

The common safety valve, though expressly designed to prevent an excess of steam, is universally admitted to be defective; and yet upon it chiefly depends the safety of the boiler, the boat, and the passengers. The defects of the valve, and of the mode of obtaining the pressure upon it, are still further increased by the *stuffing box* through which the valve rod passes: supposing every other part perfect, what accuracy can be obtained in the amount of pressure on a valve, while this injurious appendage is continued?

But the most obvious defect of the common safety valve is, that it may be loaded indefinitely at the pleasure of the attendants, and this is now so generally done, that it is of little more use than a common cock of the same diameter would be. It is generally opened and closed by a cord attached to it for that purpose, according to the tension of the steam indicated by the gauge; so that instead of being left wholly to the action of the steam, when raised to a certain pressure, its action is made to depend on the attention of the engineer! and he again is guided by the gauge! Under such circumstances we are warranted in asserting that a cock would be a substitute equally effective.

Were it not for the mercurial gauges used in boats, no accurate knowledge of the pressure of steam could be ascertained by safety valves as ordinarily used.

Of the numerous devices for preventing an excess of steam, perhaps none is of more importance than "legislative enactment," to regulate and limit the pressure of steam in boats carrying passengers, according to the material, form and internal diameter of their boilers. The strength of the boilers to be frequently tested, and the force of steam regulated accordingly. There can be no possible security for the lives of passengers in steam-boats, however strong their boilers may be, so long as the elastic force of steam in them can be increased in-

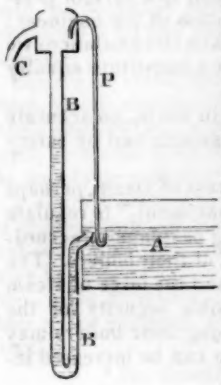
definitely, either through temerity, ignorance, intemperance, caprice, or a spirit of rivalry in contests of speed with other boats.

Of mechanical devices, perhaps the most simple and effective is, to balance the pressure by a column of water in a tube placed perpendicularly through the top of a boiler, as is often done in the low pressure boilers of stationary engines. It is one of the surest safeguards from an excess of steam, and also makes known a deficiency of water. Its introduction into steam-boats has been recently recommended by R. V. Dewitt, Esq. of Albany.

The greatest defect in this safety pipe is, that when the steam has overcome the resistance of the column, all the water above the mouth of the pipe in the boiler is blown out; neither can it be replaced until some time after the steam has been permitted to escape, since it would be blown up the tube as fast as injected by the pump. In many situations, boats with such an apparatus, would be nearly in as great jeopardy from the *want* of steam, as from the rupture of their boilers by its *excess*. The mouth of the pipe would be liable to be uncovered at times by the motion of the boat, and the inconvenient height to which the pipe would have to be carried, if applied to boilers containing steam from twenty to twenty-five pounds, is another objection. Notwithstanding, it *has been* applied to steam boats. The "Macdonough," on Lake Champlain, (as I am informed by a gentleman of this city,) had one of these safety pipes put to her boiler in 1828, which has been continued in use to the present time: its height above the boiler is about twenty feet. This boat runs from St. Albans to Plattsburgh.

It would seem difficult to derange this simple apparatus either by negligence or design; yet, in a contest of speed between the Macdonough and another boat, this very pipe was *plugged up* at the top! Several feet were added to its length afterwards.

If used at all in boats, its height ought certainly to exceed every other part by several feet, to prevent the possibility of its being closed in the manner just mentioned.



The annexed figure is designed to show how some of its defects may be avoided. A, is part of a boiler. The perpendicular height of the small pipe, P, is to be regulated to the maximum pressure of steam intended to be used. B, B, is the "safety pipe." It is continued down as far as convenient *below* the boiler, before it ascends. When the steam rises above its prescribed force, it will expel the water from P *first*, and so *give notice* to the attendants. Should the warning be neglected, both water and steam would soon be driven out of B, B. C, is to convey the hot water down. The water expelled from P falls into the head of B, B, and again descends into the boiler. It would be difficult to plug the upper end of B, B, if of the form represented in the diagram, as the end of C would also have

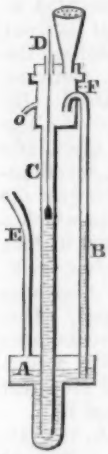
to be closed, before the steam could be improperly increased. B, B, should be *at least* six feet longer than P.

As a further security against an excess of steam, I have made an addition to the mercurial gauge, by which it will give notice of the excess; and also act (in the proportion of its internal diameter,) as an additional safety valve.

The common gauge is of itself no security against an excess of steam, any further than as it presents to the eye of the attendants an index of its elastic force.

Steam *may* be raised to a dangerous degree without being detected, and very frequently is so: an example is given in the 5th volume of the Journal of the Institute, p. 355. There are not wanting instances where the gauge has been plugged up, like the safety pipe in the "Macdonough" just mentioned.

The common gauge is adapted to the eye only, and it requires a constant examination. With the improvement I have added it addresses itself to the hearing also of all on board. The steam *cannot* exceed its limited pressure without giving instant notice, and it can only be silenced by decreasing that pressure. Its form may be that of the ordinary gauge, but the one I use is similar to that figured.



A, is an iron vessel to contain the mercury: in the centre of its bottom is a tube ten or twelve inches long, cast on it and its lower end closed.

B, is a tube whose length is equivalent to the pressure required.

C, is a tube in which a float acts. D, is the float.

E, the steam pipe.

F, another vessel to receive the mercury when expelled from B.

O, a small pipe to carry off the condensed steam.—(Water remains in F as high as O; it serves to prevent the mercury from being thrown about when forced out of B.)

The action of this gauge cock will be obvious. When mercury is poured into F, it will run down into A. Suppose A is two-thirds full, and steam admitted through E, then the mercury will be pressed up B and C, and if the steam increases above its prescribed force it will be driven out at B, when it again enters A through C.

The pipe C should be ten or twelve inches longer than B.

The action of this gauge is similar to that of the warning pipe described in last page, and which was suggested by the use of this.

Were steam boats provided with gauges of this description, (the length of the pipe B being regulated to the maximum pressure,) any attempt to exceed it would be defeated and made known; and as in the last figure, if the notice thus given, be not attended to, the whole of the mercury would soon be expelled out of A through C.

This gauge also answers every purpose of the common one.

[TO BE CONTINUED.]

Continuation of the Report of the Committee of the Franklin Institute of Pennsylvania, appointed May, 1829, to ascertain, by experiment, the value of Water as a Moving Power.

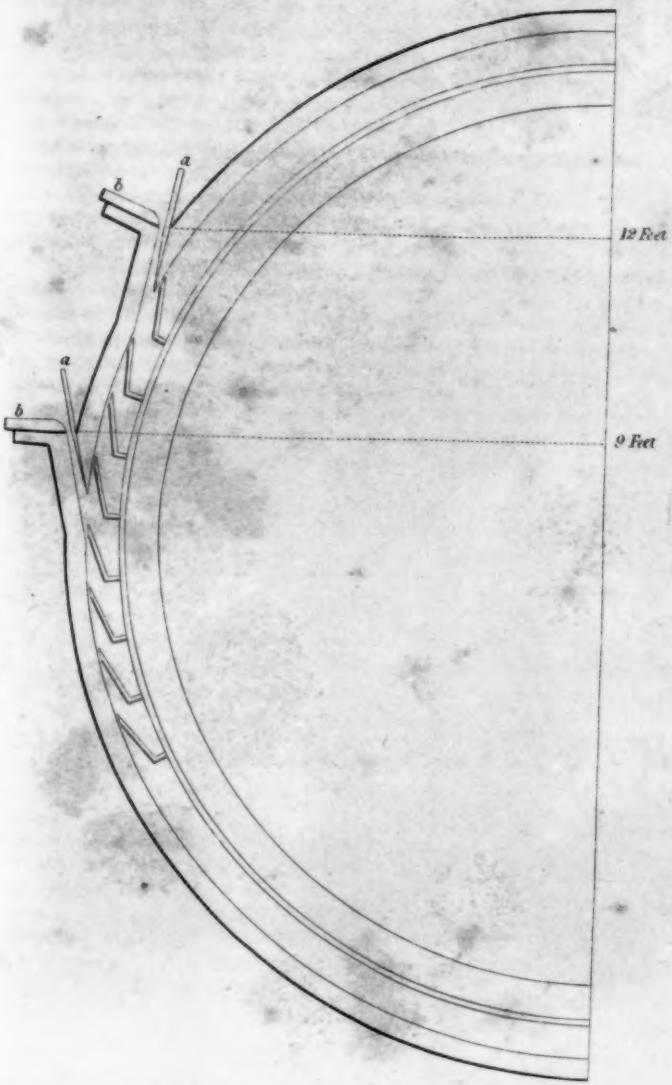
(Continued from p. 303.)

The tables which follow, (viz. e and f,) exhibit the results of a series of experiments made with wheel No. II, to ascertain the different areas of aperture, and quantities of water, required to raise a determinate weight through a given height in a determinate time, with a head and fall of fifteen feet, and of twelve feet, and with intermediate heights of water applied at the same or at different points above the bottom of the wheel. Thus to determine the comparative value of water when employed under the several circumstances embraced in the series.

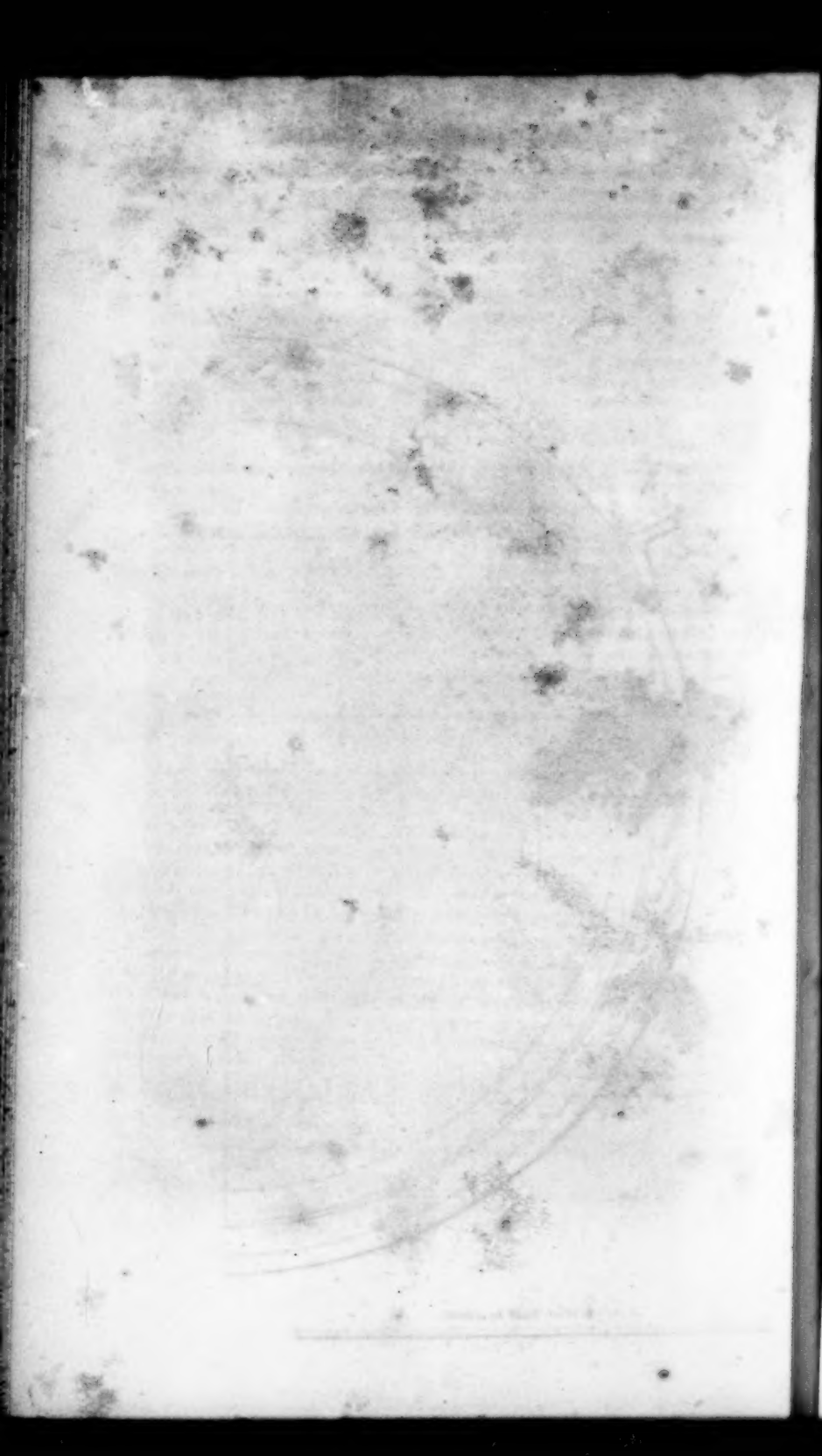
The two chutes used will be designated as A and B. Each was two inches in width by sixteen inches in breadth, and delivered the water in the same direction with regard to the periphery of the wheel. To each of these chutes was applied the arrangement of gates figured on Plate V. A gate capable of sliding upward is represented at *a*, and at *b* a false gate which could be drawn back until its front edge was even with the back of the chute; beyond this position the gate was prevented from being drawn by a permanent stop. Between the front edge of the gate *b* and the face of *a* the water passed. By moving the gate *b* forward, against *a*, the aperture was closed. The gate *a* was twenty-two inches long, one inch and a fourth thick, and at a line eleven inches from the upper end began to taper, terminating in an edge at the lower end. By lowering or raising this gate the aperture was diminished or increased. In any position in which *a* was placed, the false gate *b* could be moved forward against its face so as to close the aperture. The false gate *b* was two inches thick, the face being rounded so as to leave the smallest part of the opening at its lower edge, at which place the aperture was measured. This line was also taken as that from which to make the division into head and fall: when the gates *a* and *b* were applied at chute A, this line was twelve feet above the bottom of the wheel, and nine feet above the same point when the gates were attached to chute B.

The gates just described having been adapted to chute A, the gate *a* was opened so as to give an area of aperture of fourteen inches; in this position it was secured by screws to prevent the possibility of variation in the aperture by a movement of the gate. The false gate *b* having been also placed, the water in the forebay was raised to the height of three feet above the aperture, making a head and fall of fifteen feet. A series of experiments were then made to ascertain what velocity of the wheel would give a maximum of effect with the assumed area of aperture and head and fall, the weights being varied for this purpose.

The result was, that the maximum effect was obtained with a ve-



Scale ¾ of an inch to a foot.



locity corresponding to 36.75 seconds, and a weight raised of 706 lbs. the height through which the weight was raised being forty feet.

With this weight, aperture, and head and fall, ten experiments were made, the velocity in each being regulated as nearly as possible to correspond to 36.75 seconds; the time in each case being recorded. The head was then changed by three inches at a time until within one and three-fourths feet of the aperture. At each change of head the size of the aperture was adjusted by trial, so as to raise the weight forty feet high in a time as near to 36.75 seconds as was practicable. The proper size of the aperture having been thus found, the gate *a* was secured as before described, and ten experiments made.

The results of the different experiments with chute A are given in table e. To have determined the velocity necessary to produce a maximum effect under each head, would have added very much to the labour of the experiments. The conclusions will show the method by which the knowledge derived from the other experiments can be applied to these cases, in which instead of the precise weight and velocity appropriate to the maximum effect for the head and fall in question, those for a fifteen feet head and fall are used.

To avoid any difference in the form or dimensions of the gates applied to chute B and to A, the gates used at the former were transferred to the latter chute. Experiments similar to those described as made at chute A were then gone through, the heads above the gate being varied from six feet to two by one foot at each series. Table f contains the results of the fifty experiments made at this chute.

Table c.—Part I.

Wheel No. II.—Chute A.—*Bottom of gate 12 feet above bottom of wheel.*

No. of Experi't.	Head above gate.	Fall below gate.	Width of Aperture.	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	Wt of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Observations.
	Feet.	Feet.	In.	Pds.	Pounds	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.				
1	3.00	12.00	0.66	706	32,18	738.18	40.0	36½	7.76	2930	15.00	439500	295272	.672	
2								36	7.87	2925		438750		.673	
3								36½	7.76	2945		441750		.668	
4								35½	8.00	2935		440250		.671	
5								35½	8.00	2920		438000		.674	
6								36	7.87	2915		437250		.675	
7								37	7.65	2925		438750		.673	
8								37	7.65	2920		438000		.674	
9								37	7.65	2925		438750		.673	
10								37½	7.55	2930		439500		.672	
11	2.75	12.00	1.00	706	32,18	738.18	40.0	37	7.65	2925	14.75	431437	295272	.684	
12								36½	7.76	2915		429962		.687	
13								37	7.65	2925		431437		.684	
14								37	7.65	2930		432175		.683	
15								37	7.65	2925		431437		.684	
16								37	7.65	2945		434387		.680	
17								36½	7.76	2930		432175		.683	
18								37	7.65	2925		431437		.684	
19								36½	7.76	2930		432175		.683	
20								37	7.65	2920		430700		.685	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	

TABLE e.—PART II.

WHEEL NO. II.—CHUTE A. *Bottom of gate 12 feet above bottom of wheel.*

No. of Exper't.	Head above gate.	Fall below gate.	Width of Aperture.	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	Wt of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Observations.
	Feet.	Feet.	In.	Pds.	Pounds	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.				
21	2.50	12.00	1.07	706	32.18	738.18	40.0	36½	7.76	2945	14.50	427025	295272	.691	
22								36½	7.76	2950		427750		.690	
23								36½	7.76	2960		429200		.687	
24								36½	7.76	2950		427750		.690	
25								36½	7.76	2945		427025		.691	
26								36½	7.76	2930		424850		.695	
27								36½	7.76	2945		427025		.691	
28								37	7.65	2940		426300		.692	
29								37	7.65	2950		427750		.690	
30								36½	7.76	2950		427750		.690	
31	2.25	12.00	1.12	706	32.18	738.18	40.0	36½	7.76	2965	14.25	422512	295272	.698	
32								37	7.65	2970		423225		.697	
33								37	7.65	2950		420375		.702	
34								36½	7.76	2975		423937		.696	
35								37	7.65	2960		421800		.700	
36								37	7.65	2955		421087		.701	
37								37	7.65	2960		421800		.700	
38								37	7.65	2970		423225		.697	
39								36½	7.76	2970		423225		.697	
40								37	7.65	2980		424650		.695	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	

Table c.—Part III.

Wheel No. II.—Chute A.—*Bottom of Gate 12 feet above bottom of Wheel.*

No. of Exper't.	Head above gate.	Fall below gate.	Width of Aperture.	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	W't of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Observations.
	Feet.	Feet.	In.	Pds.	Pds.	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.				
41	2.00	12.00	1.18	706	32.18	738.18	40.0	36½	7.76	2980	14.00	417200	295272	.707	
42								36½	7.76	3005		420700		.701	
43								37	7.65	2980		417200		.707	
44								37	7.65	3005		420700		.701	
45								36½	7.76	2980		417200		.707	
46								36½	7.76	3000		420000		.703	
47								37	7.65	3015		422100		.699	
48								36	7.87	2995		419300		.704	
49								36½	7.76	3010		421400		.700	
50								36½	7.76	3000		420000		.703	
51	1.75	12.00	1.27	706	32.18	738.18	40.0	36½	7.76	3035	13.75	417312	295272	.707	
52								37	7.65	3040		418000		.706	
53								37	7.65	3035		417312		.707	
54								36½	7.76	3025		415937		.709	
55								37	7.65	3035		417312		.707	
56								37	7.65	3025		415937		.709	
57								37	7.65	3035		417312		.707	
58								37	7.65	3050		419375		.704	
59								37	7.65	3030		416625		.708	
60								37	7.65	3030		416625	*	.708	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	

* The aperture was next increased to two inches, but the quantity of water delivered was too great for the wheel to receive: the water splashing much, accompanied by the noise usual in such cases. The ratio of effect to power has always been found to diminish in similar cases, and did so in this.

TABLE f.—PART I.

WHEEL No. II.—CHUTE B.—*Bottom of gate 9 feet above bottom of wheel.*

No. of Exper't.	Head above gate.	Fall below gate.	Width of Aperture.	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	Wt of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Observations.
	Feet.	Feet.	In.	Pds.	Pounds	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.				
1	6.00	9.00	0.78	706	32.18	738.18	40.0	37	7.65	3660	15.00	54900	295272	.538	
2								36½	7.76	3675		55125		.535	
3								36½	7.76	3655		54855		.538	
4								36	7.87	3635		54525		.541	
5								37	7.65	3655		54855		.538	
6								36½	7.76	3655		54855		.538	
7								36½	7.76	3620		54300		.543	
8								36½	7.76	3645		54725		.539	
9								37	7.65	3640		54600		.540	
10								37	7.65	3650		54750		.539	
11	5.00	9.00	0.87	706	32.18	738.18	40.0	36¾	7.71	3690	14.00	51660	295272	.571	
12								37	7.65	3700		51800		.570	
13								36½	7.76	3690		51660		.571	
14								36½	7.76	3710		51940		.568	
15								37	7.65	3700		51800		.570	
16								37	7.65	3705		51870		.569	
17								37	7.65	3700		51800		.570	
18								36½	7.76	3685		51590		.572	
19								36¼	7.81	3680		51520		.573	
20								36½	7.76	3690		51660		.571	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	

TABLE f.—PART II.

WHEEL No. II.—CHUTE B.—*Bottom of gate 12 feet above bottom of wheel.*

No. of Exper't.	Head above gate.	Fall below gate.	Width of Aperture.	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	W't of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Observations.
	Feet.	Feet.	In.	Pds.	Pounds	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.				
21	4.00	9.00	0.97	706	32.18	738.18	40.0	37	7.65	3810	13.00	49530	295272	.596	
22								37	7.65	3790		49270		.599	
23								37	7.65	3800		49400		.597	
24								37	7.65	3800		49400		.597	
25								37	7.65	3800		49400		.597	
26								37	7.65	3755		48815		.605	
27								37	7.65	3800		49400		.597	
28								37	7.65	3805		49465		.596	
29								36½	7.76	3785		49205		.600	
30								37	7.65	3800		49400		.597	
31	3.00	9.00	1.11	706	32.18	738.18	40.0	36½	7.76	3980	12.00	47760	295272	.618	
32								36½	7.76	3975		47700		.619	
33								37	7.65	3975		47700		.619	
34								37	7.65	3960		47520		.621	
35								36½	7.76	3970		47640		.619	
36								37	7.65	3970		47640		.619	
37								37	7.65	3980		47760		.618	
38								37	7.65	3985		47820		.617	
39								37	7.65	3980		47760		.618	
40								37	7.65	3980		47760		.618	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	

TABLE f.—PART III.

WHEEL No. II.—CHUTE B.—*Bottom of gate 12 feet above bottom of wheel.*

No. of Expert't.	Head above gate.	Fall below gate.	Width of Aperture.	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	Worthless expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Observations.
	Feet	Feet.	In.	Pds.	Pounds	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.				
41	2.00	9.00	1.5	706	32.18	738.18	40.0	37	7.65	4270	11.00	46970	295272	.628	
42								37	7.65	4280		47080		.627	
43								36	7.87	4265		46915		.629	
44								36½	7.76	4285		47135		.626	
45								37	7.65	4270		46970		.628	
46								36⅜	7.71	4300		47300		.634	
47								36½	7.76	4300		47300		.624	
48								37	7.65	4290		47190		.625	
49								37	7.65	4280		47080		.627	
50								36½	7.76	4290		47190		.625	
1	2														
		3													
			4												
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Bibliographical Notices and Reviews.

Practical Essay on the Strength of Cast Iron, and other Metals, &c. &c. by Thomas Tredgold, Civil Engineer, &c. Third edition, improved and enlarged: London, 1831.*

This is a posthumous edition of the valuable work of Tredgold on the strength of iron. We are told in the advertisement that the work has been printed from a copy of the second edition, corrected by the author, and that the publication has been superintended by Professor Barlow, of Woolwich. The new edition is essentially the same with the second; the additions, as far as we have been able to detect them by examination, consist of seven notes, of different degrees of importance, by the author, and one by the editor. From the latter note by the editor we learn that the hope expressed by Mr. Tredgold of being able to resume his experiments upon the effect of impulsive force upon iron, had not been realized.

Tredgold presents a fine example of what may be accomplished by persevering industry, even under the disadvantages of want of early education. His works attest the extent of his labours. As given in the advertisement to the work which we have noticed, they are as follow: Elementary Principles of Carpentry, 4to. Treatise on Joinery, (Encyc. Britannica.) Essay on the strength of Cast Iron and other metals, 8vo. Additions to Buchanan's Essays on Mill Work, 2 vols. 8vo. Treatise on Stone Masonry, (Supp. Encyc. Brit.) Principles of Warming and Ventilating Public Buildings, &c. 8vo. Treatise on Rail-roads and Carriages, &c. Letter to Mr. Huskisson on Steam Navigation, 8vo. Additions and Notes to Tracts on Hydraulics, by Smeaton, &c. 8vo. Practical Rules with Diagrams for Barlow's Essay on the Strength of Timber, 8vo. The Steam Engine, comprising an Account of its Invention. Progressive Improvement, &c. 4to.

B.

A Treatise on the Strength and Dimensions of Cast Iron Beams, when exposed to transverse strains from pressure or weight: with a Table of Constants, to be used for calculating the strength and dimensions of similar Beams of Wrought Iron, &c. &c. To which is added the Theory of Bramah's Hydro-Mechanical Press. By William Turnbull. London 1831. 8vo. pp. 86.*

This is a *manufactured* work on the strength of materials. The process being as follows. Tredgold's formulæ for the ultimate strength of beams are taken; the constant multipliers from experiment, for the greatest weights borne by the material without impairing the elas-

* Com. Pub.

ticity substituted for the multipliers for ultimate strength, and the formulæ assumed to represent truly the weights which can be borne by different beams without injuring their elasticity. Thus are made out the first fifty-seven pages, entitled "Transverse Strain."

The next chapter treats of "deflection and stiffness." The first being transcribed from Tredgold, and the second altered from the same author by both subtraction and addition.

The discussion of the theory of Bramah's press, which follows, is wrapped up in equations giving an appearance of difficulty to the calculations relating to it. As a specimen of analysis this theory is not more to be commended, since of the four proportions said to contain the theory, two only are essential, the other two being derivatives. The third, by composition of the first and second, and the fourth by inversion from the second.

The author has placed himself above criticism in his preface, by assuring that he submits his work "to the public eye, indifferent alike to censure or applause—he fears not the one, he courts not the other."

B.

On the Strength and Best Forms of Cast Iron Beams.

[Continued from p. 336.]

Under the patronage of the same liberal proprietors at whose expense the experiments already given were made, our author was enabled to add to the value of his results by a third series, in which the dimensions of the beams were varied considerably: we give the remarks introductory to this third series, with the details of the first experiments.

"The beams were in this instance cast on their side in the manner of those in the first six experiments on beams; it being rather more convenient to cast them so than erect, as has been usually done in the others. The intention of these experiments would perhaps be understood by first taking the three marked 28, 29, 30, and then the next three. I will, however give the following explanation.

"In experiment 28, the model from which the beam was cast was that of experiments 19 and 20, with the bottom rib still further increased; the vertical part of the beam, or that between the flanges, being rendered a little thicker, and tapering upwards from the bottom flange. This was done to endeavour to prevent fracture taking place, by a wedge tearing out from near the neutral line, as was the case in experiment 19.

"In experiment 29, the model of the beam had precisely the same section in its middle as that in experiment 28; but the beam was twice the length. If then the strength be inversely as the length, this beam ought to bear half of that in experiment 28.

"In experiment 30 the model had in its middle section, the same top and bottom rib, as in the two preceding experiments, with nearly the same thickness of vertical part; but this beam was double

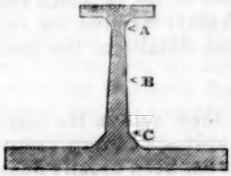
the depth of the others; it was likewise double the length of that in expt. 28, and had therefore the same length as that in experiment 29. If then the strength be simply as the depth, as we have before concluded, (article 57,) this beam ought to have double the strength of that in experiment 29; and if the strength with the same section be inversely as the length, its strength should be the same as that in experiment 28, it being double the length and depth, and in other respects the same.

"The remarks above made respecting experiments 28, 29, and 30, will equally apply to experiments 31, 32, and 33, these having been made with the same view, and only differing from the beams in the preceding ones, by having a larger bottom rib.

"60. All the beams, (except those of the common form,) were made like those described after experiment 13; with this difference, however, the parabola of the bottom rib was, in the 4 ft. 6 ins. beams, three inches longer than the distance between the supports, viz. 4 ft. 9 ins., and in the nine feet beams, six inches longer, or nine feet six inches, this was done to render the ends of the beams a little stronger, agreeably to the remarks made prior to experiment 23.

XXVIII. EXPERIMENT.

"Distance between supports 4 feet 6 inches.
Depth of beam, $5\frac{1}{8}$ inches.
Weight of beam, 81 lbs.



Dimensions of section in inches.

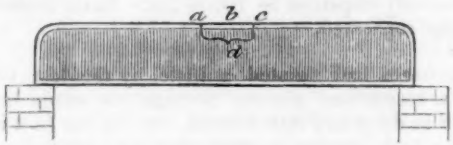
Area of top rib $2.15 \times .27 = .58$
,, bottom ,, $6.74 \times .71 = 4.785$
Thickness at A - - .25
,, at B (half way between flanges) .37
,, at C - - .53

Area of section 7.20 inches.

Weight in lbs.	Deflections in parts of an inch.	Returned to, (weights taken off.)
11056	.19	0
11746	.20	0
12436	.23	+
13126	.24	+
13816	.25	.03
14506	.27	.03
15196	.29	.04
15886	.31	
16576	.32	
18592	.36	
19600	.40	
20608	.42	
21616	.45	

22624	- - .49	- -	.13
23128	- - .50		
23632	- - .52		
24136	- - .53		
24640	- - .55		

25144 with this it broke. It is doubtful whether by tension or compression, a crack showing a wedge which *broke out afterwards*, and of which *a b c d* is the form.



a c = length of wedge = 4.2 inches.
b d = depth of wedge = 1.7 ,,
25144 lbs. = 11 tons 4½ cwt. = breaking weight.

Hence strength per square inch of section = $\frac{25144}{7.2}$ = 3492 lbs.

"To compare this with the results from the common beam, we will take the mean between those in experiments 4 and 34, they being both supposed to be from the same sort of iron, and the only ones that were cast on their sides. Experiment 4 gave 2584 lbs., and experiment 31, 3009 lbs. per inch: mean = 2796.

$$\therefore 3492 - 2796 = 696 = \text{excess.}$$

"Hence saving in metal, from section, = $\frac{696}{3492} = \frac{1}{5}$ nearly.

"If we compare this beam, by weight, with the mean weights derived from experiments 4 and 34, since in the former 40½ lbs. bore 8270, and in the latter 36½ bore 8792; taking the sums, 77 lbs. bore 17062 lbs.

"∴ 77 : 81 lbs. (the weight of this beam) : : 17062 : 17948 lbs. = weight it should have borne; but it did bear 25144, ∴ 25144 — 17948 = 7196 = excess.

"Hence saving in metal from section and ends = $\frac{7196}{25144}$ = .286.

Experiment 29. Imperfect from defects in the casting.

Experiment 30. Distance between the supports nine feet. Depth of the beam 10¼ inches. Weight 227 lbs. 28672 lbs. broke this beam, by compression, exactly in the middle. A wedge similar to that in experiment 28, but larger, was broken out. The dimensions of the wedge were *ac*, (see figure to experiment 28,) 13 inches, *bd* 5.8 inches.

Experiment 31. Distance between the supports 4½ feet. Depth of beam 5.1 inches. Weight 88 lbs. Area of top rib .52, of bottom 5.472 square inches. Elasticity impaired by 12777 lbs. Broken by tension in the middle by 28168 lbs. Strength 3565 lbs. This presents a saving in metal over the common beam of .215 lbs. derived

from the section, and the ends included, of .307, or more than $\frac{3}{10}$ths of the weight of metal.

Experiment 32. Distance between the supports nine feet. Depth of beam $5\frac{1}{8}$ inches. Weight 192 lbs. Intended to compare with the beam of experiment 28. Broken by 15196 lbs., throwing out a wedge as in figure second to experiment 28; $ac = 6.9$ inches, $bd = 2.25$ inches.

Experiment 33. Distance between the supports and depth as in experiment 30. Area of bottom rib increased from 4.72 to 5.70 sq. inches. Elasticity impaired by 19600 lbs. Beam broken by 32200 lbs. A wedge separated.

"61. The beam had twisted a little, by the last two or three weights, in a serpentine manner through its whole length, which shows that in so deep and thin a beam, the top rib (2.2 inches broad in the middle, and tapering to about half that width near the ends,) was as narrow as was admissible to support the beam."

Experiment 34. A *common beam* from the same model as that beam used in experiment 4 but cast upon its side for the sake of comparison. Weight $36\frac{1}{2}$ lbs. Elasticity impaired by 4838 lbs. Strength 3009 lbs. per square inch. This beam, and that of experiment 4, both cast upon the side, give 2796 lbs. as the mean strength of this form thus cast.

Experiment 36. A beam of the *common form* from the same model and iron as in the last experiment, but cast *erect*. Weight 37 lbs. Elasticity impaired by 4493 lbs. Broken by tension, with 9044 lbs. Strength 3188 lbs. per square inch of section.

"62. In the preceding experiments, there ought, according to supposition, (art. 59,) to have been an equality of strength between the beams in experiments 28 and 30, and those in 31 and 33; there was, however, a difference in both cases, of about one-eighth of what the larger beam bore, that beam being the stronger.

"Experiment 29 was defective, but experiment 32, where the object was the same, and which ought to have given a strength equal to half that in experiment 31 or 33, indicated, as it ought, a breaking weight whose double was somewhere between what was given by them. The discrepancies in the strength of the beams in the four experiments first named above, are considerable; but not so great as to render it necessary to seek for any other law. They may, moreover, perhaps, be accounted for by the ways in which the fractures took place; three out of the four beams having broke by the separation of a wedge, and consequently by the rupture of a part whose strength was not so well proportioned as that of the bottom rib, which must have been torn asunder first, if the beams had broke by tension.

"The superior thickness of the vertical part near the bottom rib prevented, as was intended, the fracture taking place as in experiment 19, by the breaking out of a wedge near the neutral line; but

it was only that, as in experiment 28, a wedge of a less size, and of the same form, might break out higher up, where the vertical part was thinner. It seems then probable, from these experiments, that no advantage would accrue from making the vertical part of unequal thickness.

Comparing the weights of the beams in experiments 32 and 33, with the loads they bore, we see that a great increase of strength may be obtained through a small additional weight of metal, when the depth can be increased.* This circumstance which was shown too by experiments 23 and 26, will enhance the value of the latter, and of experiments 30 and 33; especially as they are on a larger scale than any other we have made. We have not in these experiments been able to crush the top rib of the beam, though in both 30 and 33, the bottom rib was to the top one in a higher proportion than had been used in experiment 19, or in either of the former series of experiments; the ratio in experiment 33, being nearly that of eight to one. The bottom rib, in both instances, was rather too large for the thickness of the vertical part, as was evident from that part having failed the first. To have made the section then of equal strength every where, and consequently to have disposed the metal in the most economical manner possible, (which has been our principal view in these inquiries,) the vertical part of the beams should have been rendered a little thicker; and, as we have just seen, perhaps, made uniform. The top rib too, small as it was, would in both instances, possibly, have borne a reduction, only that it would have rendered the beam liable to have twisted; a tendency which showed itself in both experiments.

"From these experiments, and those commencing with 23, it is evident that, with a given top and bottom rib and thickness of vertical part, we may often beneficially increase the depth of a beam, and that to a considerable extent; but doubtless, though we have had no experiments suitable to show it, a less thickness of vertical part would have been required, if the depth of the beam were reduced, its length remaining the same. This matter has been touched on in article 33, (see also Robison's Mechanical Philosophy, vol. i. article 390,) and the experiments will throw additional light upon it; but its further consideration must be deferred to some future opportunity.

"These experiments show clearly, too, that in some of our earliest experiments, the weakness of the beams, considering the quantity of section, arose principally from the vertical part being too thick.

"Before concluding these remarks, I may further mention, that in all cases where the beam has broken by the separation of a wedge, as

"* It is not always adviseable to increase the depth of a beam, when we have the means of doing it, as it would lessen its flexibility, and render it liable to be broken by percussion, through weights falling upon it. Some experiments on the resistance of beams to impulsive forces, which I commenced on a large scale some time ago, through the liberal views of Messrs. Fairbairn and Lillie, may, probably, in an extended form, be offered at some future period to the public.

in the preceding experiments, its vertical part should be rendered a little stronger, so as just to cause it to break by tension, to which case only, the following rules for the strength will properly apply."

We may consider the second part of our author's task completed, and the best form of cast iron beams obtained as the result of his experimental investigation; the successful termination of which he manifestly owes so much to his judicious theoretical views.

The formulæ which he has deduced from his theory apply while the elasticity of the material is perfect, and we are disposed to regret that their results are not placed within the reach of the practical man in so useful a case. The results drawn from the experiments, and having reference to ultimate strength, we proceed to place before the reader. This purpose will be facilitated by collecting the results of the experiments into tables, for the sake of comparison: the plan of the author in stating each experiment separately was pursued in our detail of his labours that his remarks might appear in place.

In the deductions appended to each experiment, comparison was made of the new form with some particular beam of the common form, the early experiments with that of No. 4, which afterwards proved to be deficient in strength compared with other beams of the same form, one of which (No. 34) was cast on its side as well as No. 4. A fairer mode of comparing would be to take *mean* results. That this applies notwithstanding the differences of iron used will appear by comparing the results for different beams cast at different times with those cast at the same time. Proceeding upon this plan, we find for the strength of a beam of the *common form*, cast on its side, 2796 lbs. per square inch.

For a similar beam cast erect (mean of Nos. 10, 13, 17, 22 and 35) we have a strength of 2769 lbs. A result not differing essentially from that just given.

The mean strength of a beam of the *common form* may then be taken at 2782 lbs.

In the table which follows is presented the relative strengths of the different forms of beams experimented upon by the author, the strength 2782 lbs., being taken as unity. Experiments considered by the author to be imperfect are omitted. The series embraces all the experiments made with beams of $5\frac{1}{8}$ inches depth, and $4\frac{1}{2}$ feet bearing length. The first series includes the beams with an elliptical top rib and straight bottom rib, the second those in which the top rib was nearly uniform, and the bottom rib parabolic: these forms were described pages 266 and 326. The modes of casting will be found page 267, and are referred to by the terms there explained.

In order to show the relative *economy* of the different forms of beams, the weight must be considered. The average weight of the two beams of the *common form*, cast on their sides, was 38.5 lbs. Of the five cast erect, 39.5. Average weight of the whole 39 lbs. The value of any form in relation to economy of material, will be in direct proportion to the weight which it will bear, and in the inverse

proportion of the weight of the beam. The economy in reference to any other form will be found by taking the compound ratio of their breaking weights divided by the weights of the beams.

The average weight borne by the seven beams of the common form was 8634 lbs. the average weight of the beams 39 lbs.; 8634 divided by 39 or 221.4 will denote the value of this form in an economical point of view. This we shall take as the term of comparison in the table, calling it unity.

As the author's plan consisted in increasing the bottom rib by degrees, and only adding to the top rib when the compression required it, we shall give the ratio of the bottom to the top rib, considering the latter as unity. Thus in the table, experiment No. 3, we find in the fourth line of the second column 4; this would read, the area of the bottom rib to that of the top rib in the proportion of 4 to 1.

No. of exper't.	Ratio of bottom to top rib.	Relative strength per sq. inch.	Measure of economy.	Form and mode of casting.
Mean		1.00	1.00	Common form.
1	1	0.86	0.83	Elliptic top rib. Cast on side.
2	2	0.92	0.85	Do. Do.
3	4	0.98	0.93	Do. Do.
8	4	0.97	0.94	Do. Cast erect, not inverted.
9	4 1/2	1.15	1.09	Do. Cast erect, inverted.
11	4 1/2	1.16	1.15	Do. Do. Do.
12	5 1/2	1.21	1.12	Do. Do. Do.
21	6 3/4	1.27	1.31	Do. Do. Do.
*14	3 1/4	1.17		Bottom rib parabolic. Cast erect, inverted.
*15	4 1/4	1.15		Do. Do. Do.
18	5 1/3	1.19	1.28	Do. Do. Do.
19	6	1.47	1.66	Do. Do. Do.
20	6 3/4	1.29	1.40	Do. Do. Do.
28	8 1/4	1.26	1.40	Do. Do. Do.
31	10 1/2	1.28	1.45	Do. Do. Do.

In comparing the relative strengths per square inch in the second column, we see that until the lower rib bore to the upper the proportion of 4 to 1, the beams were deficient in strength when compared with the common form. Arrived at this ratio, the form was nearly the same in strength as the common form; the average of experiments 3 and 8 being 0.975, the excess of strength of 14 may be deemed accidental. The new form has then no advantage until the ratio of the ribs exceeds that of 4 to 1. Experiments 1, 2, 3, 8, and 14 may there-

* The weights of numbers 14 and 15 are not given.

fore be omitted in considering the cases in which the new form has advantage over the old.

The advantage of the new form increases with the increase of the lower rib, as is seen from 15, 9, 11, 12, 18, 21, 20, 28, 31; considerably in the increase of the rib from 4 to 6¾, and slowly, if at all, above this point. We cannot but regard the excessive strength of 19, (ratio 6 to 1) as accidental, since the strength of 5½ to 1 is given much lower by experiments 12 and 18, and the strength of 6¾ to 1, given by 21 and 20, is also much lower than that given by 19, while those experiments agree well together.

The saving of metal, given by the third column, keeps pace with the increase of strength of the section. The elliptical form of upper rib, with a straight lower rib, shows its inferiority in this point of view to the parabolic form of lower rib by a comparison of experiments 12 and 18, 21 and 20. The judgment of the author in varying his form in the second series is thus clearly shown.

If the remarks which we have made in reference to the results as to the relative strengths of the different forms be correct, the inferences drawn by the author (and which we are about to present) must be received with limitation. When he asserts that the strength of a beam increases nearly in the ratio of the area of a middle section of the lower rib, we must understand that the limits are on one side the ratio of 4 to 1, and on the other that of 6¾ to 1, in the areas of the bottom and top rib, and that the rule is not general for the new form of beam, but only applies to the more advantageous cases. The rule, it will be seen, is proved by experiments within those limits, and our remarks will show that it cannot safely be applied beyond them. These are, however, the cases which it is most important to consider; since, although it might be convenient to have a certain range through which to vary the size of the lower rib, to adapt it to circumstances, it could not be admissible to depart far from the best form.

The following table, in which the areas of the bottom ribs in experiments 9, 11, 12, 19, 20, and 21, as well as the actual strengths, are compared, will serve to render the author's remarks more intelligible.

No. of experiment.	Area of bottom rib in sq. inches.	Ratio of areas of bottom ribs.	Ratio of breaking weights.	Ratio of bottom to top ribs.
9	1.57	1.00	1.00	4½ a 1
11	2.20	1.40	1.35	"
12	2.89	1.84	1.56	5½ a 1
19	4.40	2.80	2.43	6 a 1
20	4.31	2.75	2.17	6¾ a 1
21	3.31	2.11	1.96	6¾ a 1

The following tables present a comparison of the experiments intended to show the relation between the breaking weights and the lengths and depths.

Distance between the supports 7 feet. Ratio of bottom and top ribs 6 to 1 nearly.

No. of experiment.	Depth of beam in inches.	Ratio of depths.	Ratio of breaking weights.
23	4.10	1.00	1.00
24	5.20	1.27	1.12
26	6.93	1.69	1.64

Distance between the supports and breadth both varied. Ratio of bottom to top rib 6 to 1. Experiment 28 taken as unity.

No. of exper't.	Depth of beam in inches.	Length of beam in feet.	Ratio of depths.	Ratio of lengths.	Ratio of depths divided by lengths.	Ratio of breaking weights.
28	$5\frac{1}{8}$	$4\frac{1}{2}$	1.00	1.00	1.00	1.00
30	$10\frac{1}{4}$	9	2.00	2.00	1.00	1.14
31	5.1	$4\frac{1}{2}$	0.99	1.00	1.01	1.12
32	$5\frac{1}{8}$	9	1.00	2.00	0.50	0.60
33	$10\frac{1}{4}$	9	2.00	2.00	1.00	1.28

"65. Comparing the results of experiments 9, 11, 12, 19, 20 and 21,* and allowing for difference of iron, as indicated by the beams of the common form cast with the others for comparison, I find that the strength is nearly in proportion to the size of the bottom rib or flange: a bottom rib of double size giving nearly, but not quite, double strength. And the subsequent experiments show the strength to be as the depth, every thing else being the same.† Therefore in different beams, whose length is the same, the strength must be as their depths multiplied by the areas of a middle section of their bottom ribs: and where the lengths are different, the strengths will be as this product divided by the lengths."‡§

To find a constant multiplier for this product of the area of the bottom rib by the depth, divided by the length, our author compares together the experiments 12, 15, 18, 19, 20, 21, 23, 24, 26, for beams cast erect, and 28, 29, 30, 31, 32, 33, for beams cast on their sides. The multiplier for beams cast erect is nearly 26, the breaking weight being required in tons, and for beams cast on their sides 25.

In accordance with these remarks we give the following rule, applicable to beams of the new form when the ratio of the bottom to the top rib is between the limits already assigned.

* See table p. 386. † See first table on this page.

‡ See second table on this page.

§ Let "W = the breaking weight in the middle of the beam, a = the area of a section of the bottom rib in the middle of the beam, d = the depth of the beam there, l = the bearing length, and c a constant quantity, $W = \frac{c\,a\,d}{l}$."

Rule.

Multiply the area of the bottom rib, at the middle of the beam, in inches, by the depth at the same part, also in inches, divide this product by the bearing length in inches.

The quotient thus found, multiplied by 26, will give the weight in tons which will produce fracture if applied at the middle of the beam; the beam having been cast erect.

For a beam cast on its side the quotient found by the first part of the rule, is to be multiplied by 25 to give the breaking weight in tons.

"*Example.*—What weight laid on the middle of one of the main beams, in the rail-road bridge, crossing Water street, Manchester, would be required to break it, supposing it cast erect, and of the same iron we have used; the dimensions from the model now constructing by Messrs. Fairbairn and Lillie being as follow:

"Distance between supports 26 feet, or 312 inches.

"Depth of beam, in middle, $27\frac{1}{8}$ inches.

"Area of section of bottom rib, in middle, $16 \times 3 = 48$ inches.

"Form of section, of beam, nearly the same as in experiment 30."

According to the rule, we multiply the area of the bottom rib in the middle of the beam, 48 inches, by the depth at the same place, $27\frac{1}{8}$ inches, which gives 1320. This product, divided by the bearing length, 312 inches, gives for the quotient 4.23. This quotient multiplied by 26, gives for the weight to produce fracture (109.98, or) 110 tons.

"These beams are intended to bear the same weight in every part; they will not, however, be quite of uniform depth throughout. The load will have to lie upon their bottom rib, through its whole length; it becomes necessary, therefore, to make that rib somewhat broader toward the ends, than according to the parabolic form described after experiment 13; and this enables the depth of the beams, near their ends, to be a little reduced."

The forms determined by our author to be the best, will of course require modification should the weight not be applied in the middle, and the rule must undergo a corresponding change. An example is given by Mr. Hodgkinson of the mode of procedure in such cases. It is that of a beam fastened by one end into a wall, a weight being applied at the other end. Such a beam being only one-fourth as strong as one of equal length to the middle of which a weight is applied to produce fracture, the numbers given by the former rule must be divided by four.

If we would determine the proper form of this beam so that it should be equally strong throughout, we must recur to our rule. By it the weight to produce fracture is proportional to the area of the

bottom rib at the middle section, multiplied by the depth, and divided by the bearing length of the beam. If we consider the strength proportional to the weight to be borne, then the area multiplied by the depth, and divided by the length, must be a constant quantity; that is, the product of the area by the breadth must vary with the length; the greater the distance from the point at which the weight is applied, the greater the product of the area by the breadth must be.

If, for convenience, we cast the beam of a constant depth, then the area of the section must be proportional to the distance from the bearing point, that is, the beam must be triangular, the weight being hung to the vertex.

"In like manner, where the weight is to be applied at the middle of the beam only, the stretched rib, then at the bottom, may be uniformly tapered from the middle to the ends, forming two triangles, instead of the parabolas before employed. In this case, the lines C A and C B* and their correspondent ones on the other side, will be straight.

"75. We might now point out other modifications in beams, and particularly in those of steam engines; which, as appears from the experiments, should have a large equal rib or flange at top and bottom, with, perhaps, a thin solid sheet between them; differing, in the size of the ribs, only, from the form in figure 26, plate 4th of Tredgold's Essay on the Strength of Cast Iron. This is for double engines, but for single ones the beam should have a large rib at top, and a small one at bottom, and be formed like that in the conclusion of the last article. But the further consideration of this matter would extend too far the limits of this paper; it would be well, however, if it were subjected to experiment, as that might tend to a reduction in the mass, and inertia, of these beams."

We have yet one subject through which to follow the author, namely, that of ultimate deflection.

[TO BE CONTINUED.]

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN DECEMBER, 1831.

With Remarks and Exemplifications, by the Editor.

1. For a *Machine for Gathering and Cleansing Fruit*, called the "apple machine;" Elias Ellis, Duxbury, Washington county, Vermont, December 5.

This machine consists of a trough, or spout, which is made in two lengths for the convenience of removal. It is to be placed upon trussels so as to form an inclined plane. The apples are to be drawn by a wooden hoe into a tray placed upon the ground; from this, they are to be poured on to the upper end of the spout, down which the

* See figure p. 326.

sound ones are to run, leaving the dirt, leaves, grass, and unsound apples behind. This is the whole affair.

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2. For *Axletrees, Hubs, and Spokes for Carriages;* Garner Wilkinson, White Creek, Washington county, New York, December 6.

The main object of this patent appears to be the fixing of the axle firmly in the nave or hub of the wheel, with a cylindrical gudgeon, or shaft, projecting out, which is to revolve in metal boxes fixed in that part of the axletree which is attached to the carriage. The apparatus, we are told, may be made of wood, or metal, and the mode of putting it together, in either case, is described; there, however, is no claim made, and as the principal feature is without novelty, we are unable, without further advice, to tell for what the patent is taken.

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3. For a *New mode of Manufacturing Tobacco;* John Allen, jr. and Charles Geoghegan, Richmond, Virginia, aliens, who have resided two years in the United States, December 6.

This improvement in the mode of manufacturing tobacco, will, it is said, save from fifty to seventy per cent. of the labour required by the old mode of making, by hand, plug and twisted tobacco, for chewing.

The lighter kinds of chewing tobacco in which the lumps vary from sixty-four to thirty-two pieces to the pound, are to be spun in the usual way, and then wound upon boards, which may be of such size as will suit the press, say four feet by three. It is then to be pressed flat, and by means of a circular, or a straight, knife, divided into lengths whilst upon the board, and thus prepared of the desired weight and length for packing

The heavier kinds, such as average from six to eighteen to the pound, are to be made into rolls of from six to thirty-six inches in length, which are then to be placed upon the board, pressed, and afterwards divided by the knife.

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4. For an improvement in the *Concave Bed of the Thrashing Machine;* Isaac S. Palmer, city of Philadelphia, December 6.

The cylinder of this machine does not differ from some others; the patent, as the title indicates, being taken for the manner of constructing the concave only. This part is thus described.

"Beneath the cylinder is suspended, on springs, a relief concave bed, which is composed of iron, or of plank, about two inches thick, and forms about one-fourth of the circle of the cylinder. In this concave are fixed a number of thin bars of iron, which are about half of an inch wide, and four inches long, notched on their upper edges, and placed obliquely, so as to point from each side downwards and to the centre; thus the straw will pass much easier, and as it will incline towards the centre of the concave bed, it will be less liable to get between the ends of the cylinder and the sides of the machine, than in machines the bars of which are placed transversely on the concave."

"What I claim as my invention, and wish to have secured by letters patent, is the form of the bars in the concave bed, and the manner in which they are placed."

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5. For a *Fly Net for Horses;* Henry Korn, city of Philadelphia, December 8.

The present patent is taken for improvements of the fly net patented by Mr. Korn on the 12th of September, 1829. It appears that specimens of the improved net are deposited in the patent office, but there is no drawing of it accompanying the specification. One of the specimens is referred to as No. 1, and we are told that the improvement in this part, which is the breast piece, consists in an alteration of the mode of attaching the end straps by buckles round the tug-eyes, &c. Now all this certainly might be represented in, and made clear by, a drawing; and the law absolutely requires it. The improvements, it is said, render the net more durable, more easily used, and more beautiful in its appearance.

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6. For an improvement in the *Plough;* James Carothers, Shirleysburg, Huntingdon county, Pennsylvania, December 10.

The claims made are to the construction of the land side; to grooves in the mould board; to the manner of securing it to the land side; and to what are called regulators.

No particular form is prescribed for the mould board, but it is to be of cast iron, and to be provided with a groove, into which a corresponding part on the land side fits, and secures it in its place. The land side is to be of cast iron, and the angles which it forms with the other parts are particularly described. There are two parts called regulators, one of which is to supply any deficiency in the mould board from wear at the bottom, the other is a screw bolt used in fixing the parts together. This patent, therefore, like most of those taken for ploughs, is mainly for the manner of uniting its parts, and not in the principle of construction.

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7. For a standing press, called the *Toggle Joint Screw Press;* Luke Hall, Hollis, Hillsborough county, New Hampshire, December 12.

In this press there are two toggle joints, which, when the pressure is taken off, recede from each other, and when it is to be exerted, are drawn towards each other until the compound bars of which each toggle joint consists stand in parallel lines. In order to draw them towards each other, the shaft of a strong screw passes through nuts properly fixed in the middle of each toggle joint, this shaft having a right handed screw at one end, and a left handed screw at the other, acts simultaneously on the joints to cause them either to approach or recede. The screw is to be turned by a crank, on the shaft of which there is a pinion taking into a wheel on the screw shaft, and capable therefore of operating upon it with vast power.

The claim is to the application of the right and left handed screw to the toggle joints, all the other parts being common.

The press, as represented, will certainly be a very powerful one, but we apprehend that there are but very few purposes to which it can be applied. The range of its platten will be small, and its action slow; and, for most purposes, these circumstances would entirely neutralize its good properties.

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8. For a *Machine for Hulling and Cleaning Clover Seed;* Alexander Matthews, Island Creek, Jefferson county, Ohio, December 13.

The external form of this machine is nearly the same with that of the wheat fan. The clover to be cleaned is put into a hopper, whence it is drawn by two fluted rollers, and delivered between two fluted rubbing boards, and thence between two cast iron rubbing plates, the contiguous surfaces of which are furnished with numerous fine teeth cast on them. The rubbing apparatus lies horizontally at the upper part of the machine, and below it are two sieves through which the seed and chaff are to pass on to a sloping board, where they are acted upon by a revolving fan. The whole apparatus is arranged on the same principle with several others, for the same purpose, and a claim to it must depend for its validity upon the construction, as specified. The claim is made to "the foregoing machine for the purpose of hulling and cleaning clover seed, or for any similar purpose to which it can be applied."

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9. For a *Washing Machine;* Miles B. Hand, Lockport, Niagara county, New York, December 14.

There are to be two reeded rollers running upon gudgeons in a frame within a trough. The gudgeons of one of the rollers run through the trough, and have a leather strap passing round them, and extending down to a treadle, by placing the foot upon which the roller may be made to revolve. A spring pole above, with a line descending from it, may serve to raise the treadle. The clothes are to pass to and fro between the rollers. The claim is to the using of two rollers only, and to the turning them in the way described.

We do not see any thing in this machine likely to redeem the character of the great family to which it belongs, and which is not in high repute.

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10. For a *Thrashing Machine and Horse Power;* John Lammon, Macedon, Wayne county, New York, December 14.

We are informed by the patentee that the improvement here made in the thrashing machine consists in the form of the teeth of the cylinder and the bed piece; and in allowing these two parts to recede from each other. The teeth are to be tapering, being about three-eighths of an inch in diameter at their lower ends, and terminating in a point. Their length is to be about three-fourths of an inch.

The horse power consists of a band wheel upon a vertical shaft, a strap from which turns a whirl on a second shaft, carrying another

band wheel, the strap of which drives the cylinder of the machine. There may be novelty in each, but we have not discovered it.

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11. For an improvement in the *Horse Shoe;* Lewis T. C. Smith, Scott county, Kentucky, December 15.

The upper side of this shoe is to be perfectly flat for some distance from the outer edge, when it is to be dishing or bevelled. The lower, or tread side, is to be raised to nearly a sharp edge along the groove which receives the nail heads. This is to cause it to take firm hold of the ground, and prevent slipping. These, and certain other points, which are particularized, constitute the claim. "All of which parts," the patentee says, "differ in principle materially, mechanically, and usefully, from any horse shoe known, or believed to be in use," &c.

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12. For an improved *Fire Place and Oven;* Jonathan Knight, Stoddard, Cheshire county, New Hampshire, December 15.

It can scarcely be said that the present patentee has given such a description of his invention as shall "distinguish it from all other things before known or used; nor has he told us what kind of fuel is to be employed in his fire place, we suppose, however, that it is to be wood. The whole description is brief and perfectly general, without any claim, or any mode of expression which indicates the parts or arrangement that he considers as new. We are told that the foundation is to be of brick or stone; that the cap is to be of stone, or iron, with two circular holes in it for boilers, and a niche at the back part of it for heat and smoke to pass. The oven may be either of stone or iron. There must be suitable funnel holes to conduct the smoke from the niche; and a piece of sheet iron is to be placed in front, forming the upper part, or breast, of the fire place.

We have not given the foregoing for the purpose of affording a distinct view of the apparatus, as we do not possess this ourselves, even though aided by the drawing in the attempt to obtain it.

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13. For a *Percussion Cannon Lock;* Samuel Ringgold and John P. Moore, of the city of New York, assignees of the inventor, Enoch Hidden, of the same place, December 16.

Several patents have been obtained for improvements in the percussion lock for cannon. Joshua Shaw, of Philadelphia, Lieut. Bell, of the U. S. army, Mr. Hidden, and Mr. Eastman, of Maine, are among the number of those whose inventions we have noticed. In the petition on the present occasion, it is said that the invention consists in the construction of "a percussion lock which is made to move horizontally, or by a side movement or motion of the cock, so as to admit the explosion from the vent to pass by without injury, and to be perfectly disengaged from the vent, the cannon and lock remaining in perfect security. The cannon, or gun, to be discharged by means of a primer, priming cap, or pellet, made of any of the percussion fulminating mixtures, of any convenient form." And in the specification the claim is made to "the horizontal or side movement or mo-

tion of the cock, to admit the explosion from the vent to pass by without injury to the lock or cannon."

14. For a *Cheese Press;* John Crane, Hanover, Grafton county, New Hampshire, December 17.

This is called the self-pressing-hanging lever cheese press. It is called self-pressing because the power applied is only the weight of the cheese and that of the apparatus within which it is placed. The construction is ingenious, and the press may undoubtedly be made to operate well. There is a frame similar to that of the ordinary standing press, and a second frame is made which fits between the cheeks of the former, is about half its height, and will readily slide up and down within it. When this inner frame is raised, the two levers which operate in pressing the cheese, approach towards a horizontal position, and when the frame is lowered they are so constructed that they approach to a vertical position, and their shorter ends bear upon a board, or follower, placed above the cheese. An accurate description of it cannot be given without a drawing. There is no claim made, and as the whole arrangement is considered new, and we believe correctly so, it was not necessary to make any.

15. For *Machinery for Washing Gold,* called the Rail-way-Car Gold Riddle; Oscar Willis, Burke county, North Carolina, December 21.

A riddle is to be prepared consisting of four pieces of timber which form the sides, and a bottom of sheet iron, which is to be perforated with numerous small holes. This riddle runs upon small wheels, the ways upon which they run forming a double inclined plane. When the auriferous gravel, or earthy matter, is thrown into this riddle, it is to be moved backward and forward by hand, one end of the riddle rising, and the other being depressed as it moves in each direction, in consequence of the inclination of the ways. Water is to be supplied which washes the gold, and other matters, through the holes on to a recipient below, whence it is conducted to a sloping trough, or ripple, with slats across it, which detain the gold, whilst the lighter parts wash over. The whole is claimed with the exception of the ripple. The patentee says that experience has proved the great value of this machine; there is nothing in its appearance, however, which would mark a superiority over several others previously in use.

16. For a *Perpetual Rotary Oven,* for the baking of bread, crackers, &c.; J. L. D. Mathies, for himself, and as the assignee of James Mathies, deceased, Rochester, Monroe county, New York, December 21.

The main feature of this oven consists in giving to its inside the form of a vertical cylinder, with a vertical shaft in its centre, which supports a circular cast iron shelf, fitting the sides of the oven so nearly as but just to clear them as it revolves upon the shaft. If preferred, the circular shelf may rest upon rollers, and revolve without a shaft.

A door opens at the side of the oven, and when articles are to be baked they are placed upon the shelf, which may then be turned round, and thus covered, or discharged, without the necessity of reaching to the back of the oven. The oven may be made exteriorly of cast iron, and lined with brick.

The fire is to be made below, the upper part of the furnace, or fire place, forming the bottom of the oven, and flues from it are to carry up the heat, and conduct off the smoke.

Cooking fires may be constructed around it for boiling and other purposes, whilst the waste heat will go to warm the oven. Above the oven, a chamber may be constructed which will be heated in a lower degree, and will serve to keep articles warm which have been cooked. This heat chamber, we are told, may extend up into the dining room, whilst the oven is in the kitchen. The oven itself, it is proposed to make from two to five feet in diameter.

There are various flues, and other parts, described, and the claim is to "all the above improvements." The revolving shelf, however, is principally relied upon.

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17. For a *Cross-cut Sawing Machine;* James W. Messenger, Windham, Portage county, Ohio, December 21.

A cross-cut saw is to be fixed in a frame within which it is properly strained. This frame is made to slide backwards and forwards between the cheeks of another frame, furnished with the proper apparatus for giving motion to the saw. This last frame is furnished with dogs which are to be driven into the log, to hold it in its proper place. A shaft is to be turned by hand, upon which there is a toothed wheel, mashing into a smaller wheel having a crank upon the shaft which operates upon two pitmen which are to carry the saw frame. The pitmen do not draw against the frame, but each in its turn pushes against the inner sides of it, so that the action upon the saw may be similar to that produced by hand.

That such a machine can be made to produce the intended effect is not to be doubted, but we are by no means certain that its use will be advantageous. It will be too cumbersome to be managed by one man, it will take some time to fix it in its place, there will be considerable friction in its various parts, and the action of the crank without a fly wheel, will not be a good one when thus applied. Upon the whole, therefore, we err greatly in judgment, if two men, going on after the old fashion, will not perform better without than with this improvement.

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18. For a *Machine for letting in Wagon Boxes;* Orlando A. Fuller, Vernon, Oneida county, New York, December 21.

The tool described for letting boxes into the hubs of wagons, will, it is said, enable a man to perform ten fold the work which he can accomplish in the ordinary way. Although some pains have been taken in drawing up the description, it is still so obscure, even with the aid of the drawing, as to preclude our attempting any explanation of it. The model would probably remove this difficulty, but to this

we do not think proper to resort, as it makes no essential part of the patent; a fact, the ignorance of which is a source of frequent error.

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19. For an improvement in the *Boilers of Steam Engines;* Isaiah Jennings, city of New York, December 21.

(See specification.)

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20. For an improvement in the *Coffee or Spice Mill;* Amasa Sizer, Cheshire, New Haven county, Connecticut, December 22.

This mill is intended to turn horizontally; but it differs, materially, in its construction from the ordinary horizontal coffee mill. The whole of it is to be made of cast iron. The lower piece, or bed, consists of a circular part which is convex, or conical, in the middle, and is cast with furrows, or teeth, as it forms one of the grinding surfaces. A rim projects up round the edge of this circular part, leaving a groove between it and the cutting surface, which groove is to receive the rim of the runner, which, with the bed, performs the grinding. The rim upon the bed piece serves to retain the ground material, until it arrives at a part where the rim is removed to allow of a lip, or spout, for its delivery. A projecting piece, or ear, attached to one side of the bed piece, and perforated with holes to receive screws, admits of the mill being firmly secured to a shelf.

The runner is a truncated, hollow cone, adapted to the projection upon the bed, and has a rim fitting into the groove before described. This is surmounted by the hopper, which is also a truncated cone, with its larger end upwards, as usual. The hopper and runner are to be fastened together by screws, and the crank, or handle, by which the mill is to be turned, is cast on to, and projects from, the upper edge of the hopper. In grinding with this mill, the hopper and runner, therefore, revolve together. A suitable screw confines the runner upon the bed piece, allowing it to revolve, and having a thumb screw under the bed piece, by which it may be tightened or regulated.

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21. For an improvement in *Stoves;* Powell Stackhouse, city of Philadelphia, December 22.

Instead of the usual construction, the oven part of this stove is to be made cylindrical, or oval, and to be double, there being one cylinder, or oval, within another, leaving a space between them which forms the flue surrounding the oven. After the heat and smoke have circulated around the oven, they escape by a pipe in the usual way.

The patentee says that whilst different kinds of fuel may be used in this stove, it is peculiarly adapted to the use of anthracite, as the heat is equally diffused around the whole oven.

There is no claim made, but the whole description goes to show that the patent is taken for the making the space between the oven and its case perform the office of a flue; in this, however, there is no novelty, as ovens have been, in numerous instances, so constructed. That described at page 231 is of this description, and we could refer to many others was it necessary so to do.

22. For improved *Bellows;* Luna Bishop, Readsborough, Bennington county, Vermont, December

The blowing is to be effected by vanes revolving in the manner of those used in wheat machines, and for other purposes. A circular drum is to be made, through which a shaft passes, carrying the blowing vanes. There are to be three channels formed by suitable partitions surrounding the vanes, and all leading to one air chest, from which a nozzle is to proceed to the fire. The circular drum is open around the revolving shaft to admit the requisite air. The patentee anticipates that the air will be forced through the nozzle of this bellows in a very condensed state; in this anticipation, however, we apprehend that he will be disappointed, for if much condensed, the very openings at which it is admitted would serve as vents for its escape.

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23. For an improvement in the *Cocoa Nut Cutter;* Daniel Fitzgerald, city of New York, December 22.

A wheel about an inch thick, and fifteen inches in diameter, is to be fixed to turn upon an axis like a grindstone; on one side of the wheel, from four to six irons are to be placed like those of a spoke shave, and there are to be perforations behind each of them through the wheel like the throat of a plane. A standard, or rest, rises from the base of the machine, and stands within an eighth of an inch of the cutter, and upon this the nut is to rest whilst it is being cut. Rows of points are also fixed upon the wheel near each of the cutters, and are made sharp to cut the cocoa nut. The claim is to "the knives and cutters on the wheel." We do not know in what way this operation has been heretofore performed, but are certain that there are machines in use for comminuting other articles very similar to that now described, and applicable to the same purpose.

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24. For a *Quilting Frame;* Brook W. Sower, Leesburg, Louden county, Virginia, December 23.

This quilting frame is essentially the well known tambouring frame enlarged, and placed upon legs. There are to be two rollers, one on each side of the frame, turning on gudgeons, and furnished with rag wheels and palls at their ends. A strip of list, or webbing, is fixed upon each roller, for the purpose of attaching the quilt.—A modification is proposed, which renders the rag wheels unnecessary. Holes are to be made around the ends of the rollers to receive pins, which resting against the frame, or other stop, will serve to secure them in their places.

We presume that the tambouring frames with their rag wheels and palls may still be used with impunity, but should the workman mistake the dimensions given, and make them large enough for a bed quilt, its use is fore (or rather *hind*) stalled, by this patent, the invention consisting in "the before described quilting frame, and the last described modification of the same."

25. For a *Washing Machine;* David Watson, Fayette, Kennebeck county, Maine, December 23.

A box or trough, has rollers fixed upon the bottom of it, extending across it, and forming, longitudinally, a segment of a circle. A vibrating frame, furnished with similar rollers at its lower end, is to be passed backward and forward over the clothes to be washed. So far this machine exhibits all the features by which a very numerous family is designated; but, in general, the gudgeons of the vibrating frame have rested upon spiral or other springs, admitting of its adaptation to the thickness of the clothes; in the present instance, the genius of invention has suggested a substitute for these springs, by putting pulleys on the upper ends of the standards which support the vibrating frame, allowing cords attached to the frame to pass over these, with weights on the ends of the cords which shall be a counterpoise to it. The patentee says, "What I particularly claim, and for which I ask an exclusive right, as my mode of suspending the rollers, is that above specified." We take the liberty of suggesting to the next improver of the washing machine, that a weighted lever, or, if he prefers it, two weighted levers, may be made to answer the same purpose as that which is to be effected by pulleys and ropes.

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26. For a machine for *Netting Pine Apple Cheeses;* William Starr, Norway, Herkimer county, New York, December 27.

The cheese after being taken from the moat, or mould, is to be put into a net of suitable structure. The lower part of the net is to be fastened to an iron, or other strong bar, fixed across a frame; the upper end is to be fastened to another bar, which may then be raised until the twine of the netting properly indents the surface of the cheese; the ends of the bar are then to be slipped over pins which project from the frame, and it is retained in its place. The patentee says that "the cheese can be netted in this way with greater ease and expedition than by any other heretofore in use."

A patent was taken some time since for preparing the moulds of such cheeses so as to give the impression without netting; the pattern being carved or cast within the mould.

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27. For an improvement in *Steam Boilers;* Philo M. Hackley, Herkimer, Herkimer county, New York, December 27.

The steam engine boiler which is the subject of this patent is to be formed of several vertical, concentric, double cylinders, closed at both ends; each of them is to be kept filled with water, and they are to be connected together by proper tubes; they are, generally, to be placed vertically upon the bars of the fire place; the heat and flame are to pass up in the spaces between these cylinders, and, consequently all of them but the exterior cylinder, exposed to its action on both sides. A metallic dome, somewhat convex upwards, covers the whole of the interior boilers, and is fastened to the edge of the inner plate of the exterior boiler. Above the first dome there is a second which is hemispherical; this is attached to the outer plate of the ex-

terior boiler, and forms the top, or cap, of the whole. The water is to rise to a considerable height in the space between these two domes; this water communicates freely with that in the outer boiler, and this in its turn being connected with all the others, by water ways, the whole is to be considered as forming one boiler. It is proposed also to make the bars of the grate hollow, so as to be filled with water, and to connect them with the cylinders.

The foregoing is a mere outline of the general plan, it not being necessary here to notice the supply pipes, water and steam cocks, and other usual appendages to steam boilers, or to particularize the auxiliary contrivances which are described by the patentee; it is necessary, however, to the understanding of the claim, to state that it is proposed to cause the heat and flame to ascend spirally between the boilers, by means of a screw-like partition running up between them, which tends to support them, and likewise to preserve them in their concentric positions.

The claim is to the combination, in one boiler, of two or more cylindrical boilers, all united by tubes, or connected by one common cap; the resting of the inner cylinders upon hollow supporters, and the employment of water tube fire grates, connected with the boilers.

It appears to us that the above claims are too general, as concentric cylindrical boilers are not in themselves new, nor is it new to construct the grating of furnaces hollow, and connect them with the boiler; we apprehend, therefore, that the claim should have been confined to the particular arrangement adapted by the patentee.

Independently of the question of originality, that of utility presents itself as one of great importance, and from reasoning, as well as experience, we are led to the conclusion that boilers, bars, and tubes, constructed and connected like those described, will frequently fail in performing the duty assigned to them. The steam generated in bars and tubes will often exclude the water, and then the action of the fire will destroy them; this has frequently happened, and we do not perceive any thing in the present arrangement to secure this apparatus against the same fate.

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28. For an improvement in the *Caulking of Ships or other Vessels;* Nicholas W. Chevalier, city of Baltimore, December 27.

In the common mode of caulking, the seam between the planks is wedge-shaped, in consequence of which the caulking is apt to start, from the working of the vessel; to prevent this the patentee makes a groove, or hollow, on the edge of each plank; this is filled up by the caulking, which thus forms a tongue, retaining it in its place. The claim is to the forming of this groove.

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29. For an improvement in the *Plough;* John Deats, Roxburgh, Warren county, New Jersey, December 28.

This is to be a cast iron plough, consisting of several parts put together in a manner particularly described in the specification. We shall not attempt any description, but merely give the claim of the patentee, which is to "the before described improvements in the mould

board; the main land side; the bottom land side; the cutter; the projection, or ear, on the share, and space in the same at the heel; the plate of iron under the share; and the dovetailed piece of cast iron in the end of the beam."

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30. For a *Machine for Sawing Furrow Boards;* Nathan H. Dearborn, Conway, Strafford county, New Hampshire, December 28.

The term furrow boards is new to us, and we are not able to learn from the specification the use to which they are to be applied; we perceive, however, that they are to be sawed winding, and that very considerably. There is to be a carriage, a saw frame, and a pitman, made in the usual manner, but the saw is to have a twist in the frame to correspond with the winding cut to be given to the log. The machinery by which this winding motion is given to the log is so constructed as to cause it to turn upon pivots as the carriage proceeds. This machinery is but imperfectly represented in the drawing, which is without written references; if well drawn, however, it is too complex to be made plain by verbal description alone. There is no claim, the general arrangement of the machine being considered as new.

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31. For machinery for *Propelling Mills, Vessels, Carriages,* and other machinery, by manual labour; Joseph G. Aldebert, Parish of St. Landry, Louisiana, December 28.

Whenever we meet with machinery for propelling machinery, we are instantaneously prepared to repel that invasion of the laws of nature of which such contrivances are almost uniformly the precursors. The idea of putting a man at one end of a machine, and placing between him and the other end a combination of wheels, pinions, and levers, which shall enable him to communicate the power of an elephant at the end of the train, is one which we have never had occasion to repudiate, because we never consorted with it, having in our first lessons in natural philosophy learnt its absurdity. So much for our *proem,* and now for the conclusion of the specification before us, in which we are told that "the lever or levers being worked up and down by the hand, or otherwise, push round the ratchet wheels by means of the rods from the levers to the projections, or arms, on the small wheels; the palls fall into the notches and connect the small with the large wheels, and thus force them round with them. One of these wheels works into the pinion, which gives motion to one of the fly wheels, the other being moved by the levers and bridles. The motion thus generated can be communicated, by proper gearing, to mills or any kind of machinery."

Those who have gone no farther on the road of mechanical inquiry than over the *pons assinorum,* will not need a more extended account of the means and ends of the patented machinery indicated by the foregoing article, to allay all further curiosity respecting it; with those who have not yet set out on the journey, or who have mistaken the road, we have not, at present, time to hold a long talk, and a short one would assuredly be waste of words.

32. For an improvement in *Making Ropes, Cords, Cables, Tow Lines, and Cordage in general;* Aaron Bull, Caroline, Tompkins county, New York, December 29.

The patentee of this improved rope has gone upon the correct principle that some of the metals are stronger than hemp, but we apprehend that in this instance he has failed in the attempt to apply the principle, or fact, to a useful purpose. He, however, is so brief in the description of his invention, that we can give the whole to our readers and still occupy but little space. Threads sufficient to form a strand are to be taken, and in forming it wire is to be laid in the centre of it so as to form the heart. After the several strands are thus prepared, they are to be laid together in the usual way.

We are not told what kind of wire should be employed, and are at a loss to say what will answer the purpose. Iron will rust, gold will be too dear, and most of the metals having but little tenacity, must be counted out. Even copper, the most promising of the family, will break by repeated bendings, and will not yield like the more elastic parts of the strand. We are really apprehensive that if any advantage be derived from this patent it will be confined to the wire drawer, and that the consequent increase of his business will be of but short duration.

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33. For an improvement in the *Skate*, and the mode of manufacturing the same; William Whitaker, city of Troy, Rensellaer county, New York, December 30.

The claim of the patentee will at once indicate the nature and merits of the invention, it is as follows:

"What I claim as new, and as my own invention, or discovery, in the above described skate, manufacture, or improvement, and for the use of which I ask an exclusive privilege, is the application, or use, of cast iron, or other metal, either separate or mixt, (which may be cast,) in producing, or forming, by the operation of cutting the said metal, or metals, entire skates, (excepting straps or strings,) each in one piece, without wood, joint or screw, pin or rivet, and so constructing the same as to combine in a sufficient degree, lightness, permanence, and strength."

The only objection to these skates, which we perceive, is, that being made wholly of a good conductor of heat, they will be much colder to the feet than those mounted in wood. We have no experience in the business ourselves, but have heard this complaint respecting skates mounted with sheet iron. Every horseman knows the difference in cold weather between keeping his feet in, and disengaging them from, the stirrup. With the exception of the circumstance mentioned, we apprehend that this skate is, in all points, a real improvement.

Specification of a patent for an improvement in the Boilers of Steam Engines. Granted to Isaiah Jennings, *city of New York, December*, 1831.

To all whom it may concern be it known, that I, Isaiah Jennings, of the city of New York, have invented an improved mode of constructing boilers for steam engines, which improvement is particularly applicable to the boiler heretofore patented by me, but is also applicable to boilers of other constructions. The following is a full and exact description of the boiler as now constructed by me; not intending, however, to confine myself to any specific form or dimensions, but only to render manifest the principle upon which I proceed.

I usually construct my boiler with the exterior form of a cylinder standing vertically. This cylinder may be about twelve feet long, and three feet two inches in diameter. The interior of this boiler is in the form of a truncated cone, which will have the same length with the cylinder, and may be about two feet ten inches in diameter at the bottom, and ten inches at the top. A second conical part is also provided, of the same length with the former, but two inches larger in diameter throughout. These three parts are to be firmly connected together, both at top and at bottom, and between them is the reservoir for water and steam, and within them the fire and heated air passes. The top of the boiler, to which the cylinder and cones are secured, is perforated in the middle for a flue, and has the requisite openings for a steam pipe, valves, &c.

The larger cone is to be perforated with rows of holes at top and at bottom, to open a free communication for water and for steam between the exterior and interior spaces formed by the cones and cylinder. At the top, these holes may amount to a dozen, and half that number will suffice at the bottom. The row at top may be within an inch of that end, but those near the bottom had better be six inches from the lower end. I make them usually about one-eighth of an inch in diameter, and to preserve them from corrosion, and furring up, I usually bush them with gold, or platinum.

Besides the three parts above described, I cause a truncated cone of sheet metal to descend from the top of the boiler to the depth therein of about three feet; allowing about the same space between it and the larger cone as that between the two cones. By means of this, the steam which passes through the upper holes from the interior to the exterior space, is conducted down towards the surface of the water, which stands in the boiler at about two-thirds of its height.

Should a boiler of this description burst, the rent will always take place in the interior, or smaller cone, which is exposed to the fire, and no where else. When such a rent does take place, no more water or steam can be suddenly discharged than that which is contained within the inner space, which upon fair and repeated trial has not

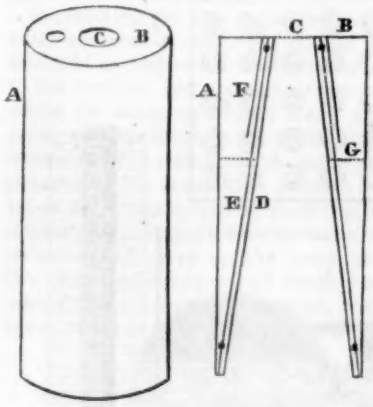
been productive of the slightest personal injury. The smallness of the holes establishing a communication between the two chambers preventing any rapid discharge of the great body of water.

What I claim as new in the present arrangement, is the combining together of the three metallic vessels, so as to form two interior spaces, or chambers, for water and for steam, and the establishing a communication between these spaces, in the manner, and for the purposes herein described: intending to apply the same principle to such boilers now in use as will admit thereof, although they may differ greatly in form from that described.

I also claim as new, and as my invention, the bushing of the holes with metals not liable to corrosion.

ISAIAH JENNINGS.

Jennings' Boiler.



A, cylinder.

B, head.

C, opening for flue.

D, inner truncated cone.

E, larger truncated cone.

F, short truncated cone.

The dots on the larger truncated cone, at top, show the steam holes, at bottom, the water holes.

G, height of water.

ENGLISH PATENTS.

Specification of the patent granted to JACOB PERKINS, *of Fleet street, in the city of London, Engineer, for improvements in generating Steam. Dated July* 2, 1831.

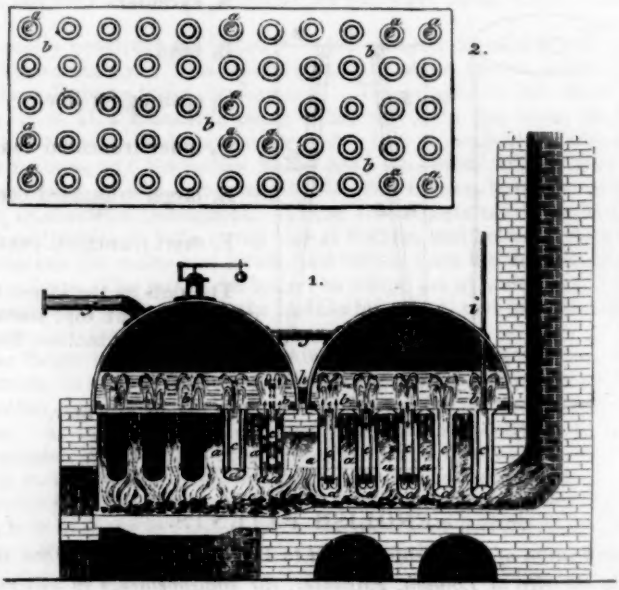
To all to whom these presents shall come, &c. &c. *Now know ye*, that in compliance with the said proviso, I, the said Jacob Perkins, do hereby declare the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained in and by the following description thereof, reference being had to the drawings hereunto annexed, and to the figures and letters marked thereon, (that is to say):—

My invention is that of a new method or methods of producing a rapid generation of steam, and consists in an apparatus that may be

constructed with, or superadded, to the steam boiler or generator of steam; this apparatus may be considered as a lining to the internal surface of the boiler or generator, admitting the water to circulate between the two, by passages that are left open at the lower and upper parts of the lining, whereby the heat given off from the inner surface of the boiler, will be rapidly carried up to the surface of the water, and given off with the steam, and such boilers may have a higher degree of heat applied thereto without injuring the metal.

This invention may be more fully understood and carried into effect by the drawings hereunto annexed, which represent the apparatus as applied to three descriptions of steam boilers, by way of example; and I would observe that in each of these drawings, and the figures there shown, the same letters refer to similar parts.

Fig. 1.



Description of the Drawing.

No. 1, Fig. 1, represents the apparatus applied to a boiler constructed with a number of tubes or compartments, descending from the main body, so as to come each into contact with the fire in the furnace, and thereby presenting a more considerable surface to the heat, as will be evident by inspecting this drawing. These tubes are denoted by the letter *a* respectively; the letter *c* represents internal tubes to the tube *a*, open at bottom and also at top; and these are the linings which constitute the invention or improvements. The inner tubes *c* rest on the inner area of the bottom of the tubes

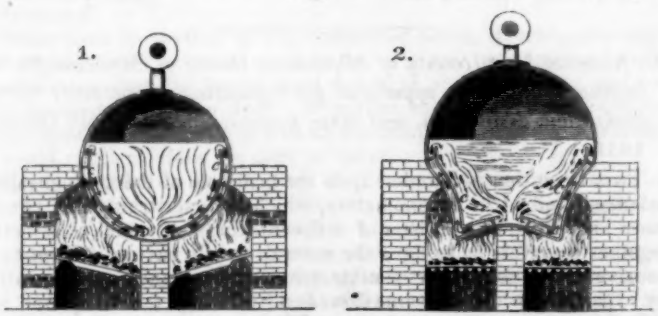
or compartments *a*, on the legs or supports *d*, which keep the inner tubes or linings *c* in their proper places, and leave a space all around as well as at the bottom, to produce the circulation more fully described hereafter.

This boiler is formed of two separate parts, *e* and *f*. No. 1, represents a cross section of the boiler, *g* being a steam pipe which connects the upper parts of the two, and is for the purpose of equalizing the steam therein; *h* is another pipe which connects the water, and keeps it on an equal level in the two; *i*, the water supply pipe; *j*, the steam pipe leading to the engine.

No. 2, Fig. 1, is the plan of the bottom of one of the parts or boilers *e* and *f*, showing the position of the tubes *a* and *c*. With respect to the other necessary parts of the boiler, which are known to every person acquainted with this sort of machinery; it is not deemed necessary to enumerate them, as they are not essential to explain the invention.

On lighting the fire in the furnace, the heat will strike against the outer surfaces of the tubes *a*, and thus give off heat to the water which is in contact with the metal, and such heated water will rise to the surface, and give off so much of it as is converted into steam, whilst the inner column of water contained in the tubes *c* will descend, and continue to fill up the space of that part which has become heated, and is rising to the surface; and thus will a very rapid circulation of the water take place in each of the tubes *a*, caused by the tubes or linings *c*, and by such rapid circulation, however great, the degrees of heat applied to the outer area of the tubes *a*, the rapid circulation will carry up the same, and give it off at the surface with the steam, and thus at all times keep the tubes *a* at a temperature which will not injure the metal, which would be the case were the inner tubes or linings *c* not used.

Fig. 2.



No. 1, Fig. 2, represents the section of a cylindrical steam boiler, such as is usually employed for high pressure engines; and No. 2 is a section of what is termed a wagon boiler, such as is used for low pressure engines. In each of these two figures I have not thought it necessary to show the construction of those boilers, more particu-

larly, they being well understood, and in very general use, the only difference being the addition of the linings *c*, which are curved plates running from end to end of the interior surface of the boilers, but kept apart from each other at the bottom, to admit the passage of the water between them, and kept open and apart from the boiler at the top for the same purpose, such plates being kept to the positions shown in the drawings by means of short rods, which are rivetted or otherwise affixed to the sides of the boiler, and also to the linings *c*. The linings *c* are for the purpose of obtaining a rapid circulation of the water, as described with respect to No. 1.

In Nos. 1 and 2, Fig. 2, it will be seen that I use two separate fire places or furnaces, the object of which is, that the partition of brickwork which runs the whole length under the boiler, should prevent the fire acting under that part of the boiler, by which means the water over such brick-work always contains less caloric than that which is directly acted upon by the fire; and by the action caused by the partitions or linings *c*, a rapid circulation will be produced, which will take up the heat more quickly from the inner surface of the boiler, and give it off with the steam.

Having now described the nature of my invention, and having shown my improvements as applied to three descriptions of steam boilers, it will be evident from the nature of the invention, that the shapes of the boilers may be varied without departing from my invention, which I hereby declare to consist in applying the linings, *c*, by any apparatus, upon the principles and by the methods above described, for the purpose of obtaining a rapid circulation of the water in steam boilers or generators, and thus causing the water to take up the heat from the inner surface of such steam boilers or generators, and thereby producing a rapid generation of steam, with less injury to the metal or material of the boiler, as above described.

In witness whereof, &c. [*Rep. Pat. Inv*

To ANDREW URE, *county of Middlesex, Doctor of Medicine, for his having invented an apparatus for regulating temperature in vaporization, distillation, and other processes. Sealed 20th October,* 1831.

THIS invention is founded upon the principle of the compensation balances applied to chronometers, which are constructed of two or more long slips, or thin bars of different kinds of metal, connected together by rivets or solder; the several metals having different expansive properties under similar temperatures, and, consequently, by expanding when in connexion, bend or warp the compound bar out of its original form or figure. The apparatus is called a Thermostat.

The principle admits of being variously modified in its construction, and may be applied in many different situations, where a varying temperature can act upon it, for the purpose of becoming a self-moving agent. The intention of the patentee is to adapt this con-

trivance to distilling apparatus particularly, in order that by its expansion, or contraction, it may open or close a water cock, and thereby admit such a regulated current of the cooling fluid as shall at all times keep the materials under operation at a uniform temperature. The same contrivances are also applicable to regulating temperature in stoves and heating apparatus of various kinds.

The construction of the proposed apparatus admits of almost as many varieties as its adaptation; the patentee has exhibited several, merely as illustrations.

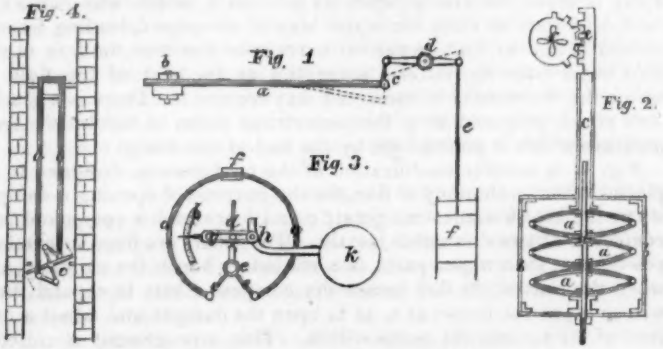


Fig. 1, shows one mode of applying the contrivance; *a*, is a bar, composed of two thicknesses of metal, brass, and steel, united, and made fast at the end *b* to the place where it is to be used, which may be called its fulcrum. At the reverse end, *c*, a link connects the bar to a lever *d*, which by the rod *e*, raises and depresses a sliding door or damper *f*.

When heat is applied to the compound bar *a*, it elongates, and that metal, which expands most under a given temperature, being uppermost, causes the bar to bend down, as shown by dots, and by that means to raise the door. If placed within a boiler, the same might open a cock or valve, and on the temperature being lowered, it would rise and close the cock or valve.

Fig. 2, is another modification of the contrivance, consisting of several pairs of compound metallic bows, *a a a*, connected together, the lower one of which is fixed by an adjustable screw to the bottom of the box *b*, and the upper one to a sliding rod *c*. The outer parts of these bows being composed of metallic bars, which are more readily susceptible of expansion by heat than the inner parts. On the temperature of the surrounding medium becoming increased, the bows rise upon the central pin *d*, and in so doing lift the rod *c*, which having a rack, *e*, at its end, turns the circular piece, *f*, upon its centre, and thereby opens a ventilator, or turns any other apparatus, by which a cool current may be admitted. When the temperature of the surrounding medium becomes lowered, of course the bows flat-

ten, and come closer together, drawing down the rod *e*, and closing the ventilator.

Fig. 3, shows the thermostat in a circular form, that is, a hoop, *a a*, constructed by uniting two thin slips of dissimilar metals. At the open parts of the hoop two levers, *c c*, are attached by joints, and which levers are connected together, and to a sliding rod, *d*, at the joint *e*.

If this hoop, *a a*, be fixed at the part *f* in a vessel, the varying temperatures of which are required to be known, the different degrees of heat will cause the hoop to expand and contract, and in so doing to move the arm *g*, upon its fulcrum *h*, which will cause the cock *h* to open or close the water way of the pipe *i*, leading from a cistern *k*, and by that means to increase or diminish the flow of the cold water from the cistern, according as the heat of the fluid in which the thermostat is immersed may require it. There is a graduated arc, *l*, proposed as a thermometrical scale, to exhibit the temperature which is pointed out by the end of the arm *g*.

Fig. 4, is another modification of the contrivance, designed to be placed within a chimney or flue, for the purpose of opening a damper when the heat becomes too great; *a* and *b* are each a compound bar, composed of two dissimilar metals. These bars are fixed in pendant positions at their upper parts, to a stationary bar in the chimney, and when the heat of the flue causes the compound bars to expand, they will so move the levers at *c*, as to open the damper and admit a current of air to cool the parts within. This arrangement is called a pyrostat.

It must be repeated, that these are only illustrations of several constructions and modes of adapting the principle, but the patentee claims generally the adaptation of combined bars of metal, whose properties render their opposite surfaces susceptible of different degrees of expansibility, under any given temperature, for the purpose of moving levers, or otherwise operating to open or close valves, cocks, or registers, for regulating the temperatures of fluids, or airs, for refrigerating or ventilating. [*Lond. Jour.*

To WILLIAM MANN, *county of Surry, gentleman, for his having discovered, or found out, that by the application of compressed air, power and motion can be communicated to fixed machinery, and to carriages, and other locomotive machines, and to ships, vessels, and other floating bodies. Sealed* 1*st June*, 1829.

FROM a perusal of the above curious title, it would appear that the patentee had no knowledge of the application of compressed air in the air gun, or of its adaptation in a thousand other ways, to obtain mechanical power; but even if it had not been known before, his having merely discovered, or found out, that by the application of compressed air power and motion can be communicated to fixed machinery, and to carriages, &c. &c. is not a discovery upon which a patent

can be granted; because the discovery itself is not a vendable matter; whoever therefore, has dictated the title of this patent, has omitted that which should have been the very essential part of it, (viz.) that he has invented or discovered a *mode of compressing, or of applying* compressed air, &c. We take this opportunity of pointing out the fatal effects of an erroneous title, convinced that in the present instance, we are not, by the exposure, subjecting a new or useful invention to the jeopardy of legal consequence, and may perhaps be communicating a hint that will be found useful to future patentees.

The specification, which is extremely long, commences by telling us that atmospheric air may be compressed in close iron or other vessels by means of manual or animal labour, by wind mills, water mills, steam engines, and other means, and that when so compressed, the vessel containing the air may be conveyed from place to place, and may be stationed in any required situation: and the air may be let off from the vessel in small currents, and allowed to expand, so as to communicate by its elasticity a mechanical power capable of actuating, or impelling, machinery.

The common mode of compressing air, is by forcing it into a strong vessel, by means of an air pump, by which a large volume of air, at the usual density of the atmosphere, is taken and compressed into a small compass within the close vessel: the pumping operation being continued until the air within has reached that degree of density, or compression, required.

This the patentee proposes to do, by means of a series of air pumps connected together; the first pump compressing the air perhaps ten times, and the second ten times, bringing the condensation to a hundred times that of the natural atmosphere, and so on to any degree of density that may be desired. It is observed that this will not reduce the whole amount of mechanical labour requisite to bring the air to the same degree of condensation, by a single pump, but yet it is to be preferred.

There is to be a reservoir connected to each pump, to receive the air as it is forced in, and a valve to prevent its returning, from which reservoir the condensed volume is taken by the second pump, and still further compressed as we have said above. No drawings accompany the specification illustrative of the patentee's plans, but several elaborate tables are given, showing the required dimensions of the pistons and chambers of the series of pumps, diminishing in arithmetical progression.

When suitable, strong vessels have been thus charged with condensed air, the vessels may be conveyed to the situations in which they are to be employed for actuating or driving machines, and the compressed air being then let out from the vessel, in small quantities, into a receiver, is there allowed to expand to a certain volume or pressure, when it may be admitted into a working cylinder, for the purpose of raising or depressing a piston by its elastic force, in the same manner as steam is applied.

In this way it is proposed that condensed air should be employed as a power, in preference to steam, for driving locomotive engines

and carriages, propelling vessels on water, and working machinery in general. Vessels containing this condensed air may be transported from place to place, like portable gas, for actuating lathes and other small machinery, where steam engines would be inconvenient; and the air, in its condensed state, may be conducted to any part of a manufactory by means of pipes, in the same way that Mr. Hague works his cranes at St. Katharine's Docks.* It is further proposed to employ this power in fortifications for discharging ordinance, by conducting the condensed air through tubes from a reservoir, to any part of the ramparts.

In order to obtain condensed air in large quantities, steam engines are to be employed to work the air pumps; or wind mills, water mills, and, in many cases, the tread mills of prisons may be made available for this purpose.

When the power is to be applied to locomotive carriages running from one town to another, steam engines should be erected, at not more than ten miles apart, to supply the vessels with condensed air as they become exhausted; and in the event of a line of locomotive carriages being established between London and Newcastle on Tyne, the surplus coal may be usefully employed in the neighbourhood of the collieries for producing steam to generate a power for condensing the air, and the vessels may be conveyed to different stations on the road, ready to be taken up for use. (See the specification of C. C. Bombas, for propelling, &c.)†

We presume that enough has been said in the above report to convey a tolerable notion of the scheme proposed by the patentee. It is not necessary for us to say another word as to the originality of the idea suggested, or of the practicability of the project; its obvious absurdity and uselessness must be perfectly evident.

[*Lond. Jour. March*, 1832.

Patent granted to ADOLPHE JAQUESSON, *of the county of Middlesex, Esq. for certain improvements in machinery applicable to Lithographic and other Printing. Communicated by a Foreigner. Dated July* 6, 1831.

THE patentee is not the inventor of this complex machinery. It comes from abroad. None of its parts are new, but for their original combination, and novel application, the patent is claimed. The machine itself will be found extremely useful: it is a printing press, whereon impressions may be taken from a steel or copper plate, a wooden block, a stone, or a form of type. Engraving, lithography, and printing, all by one process! There are a frame of strong angle iron, a sliding table, a cylinder, and the means of motion and communication.

The principle of the rolling press is evidently that which is here used. The table moves in grooves, or by a rail-road, and the cylin-

* Lond. Jour. 2nd series, vol. i. p. 95. † Ib. vol. ii. p. 278.

der is lifted up so as to justify its space to the different substances, from the copper plate to the block of stone. Proportionate weight is given, so as to regulate motion—into quick for utility, slow for excellence. Cog wheels and flies are the instruments of motion. Any power may be made to act. The motion of the table is horizontal, under the cylinder to receive the pressure, and back again to be inked. The action of the cylinder is, of course, rotary on its axis. The whole machine differs little from the usual rolling press: its great distinguishing feature being the power of elevating or depressing the cylinder, so as to allow it to act with regulated pressure on a thin substance, or on a thick one. The inking process is the same as that used in the usual presses. There is no doubt that (if the materials be reasonable, and the machine portable) it will be useful and popular.

Patent granted to Baron CHARLES WETTERSTADT, *county of Middlesex, for a composition or combination of materials for sheathing, painting, or preserving ship bottoms, and for other purposes. Dated July* 6, 1831.

MR. WETTERSTADT's "composition or combination" for sheathing ship bottoms, &c. consists of regulus of antimony and lead; 100 parts lead, and from three to ten per cent. of antimony, boiled, stirred and skimmed. When thoroughly combined, it is poured into cast iron moulds of sixteen inches, by eight and a half inches of superficies, and half an inch thick. The plates when cold are passed between rollers and flatted out to sheets measuring thirty-four inches by sixteen inches. The next process is to paint these sheets with an amalgam composed of two parts lead, melted with one part antimony, and seventeen parts quicksilver, heated to 300° or 400° of Fah. [An ample latitude this, in an accurate detail of a specified process.] The amalgam to be stirred, and cooled down to the consistency of honey, when the sheets are to be painted with it; [no direction is given as to the portion of amalgam to be laid upon each sheet] and afterwards passed between the rollers as before, but in an opposite direction, and flatted out till they are from fifty-two to fifty-eight inches long, and sixteen inches wide. When the sheets are destined for the roofing of houses, and similar employment, the additional process just described is not requisite.

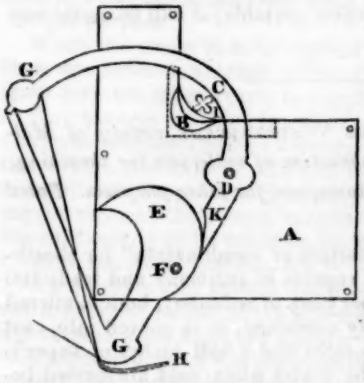
The *paint* for ship bottoms, paling, and other outside work, is composed of finely sifted dross and sulphur; equal parts of each melted together, and so carefully as that the sulphur may not take fire. The material is laid upon the ship, paling, &c. either by previously heating these, or by means of hot flat irons of such a temperature as not to fire the sulphur.

Mr. Wetterstadt states that his reason for confining himself to from three to ten parts of antimony, to the 100 parts of lead, in the composition of the sheathing, is, that the latter proportion would ren-

der the metal too brittle, and that the former quantity would be too small to produce the effect he requires: then why not state the exact proportion of antimony he deems the most beneficial to his purpose?

The patentee does not insist upon the employing of copper nails in his sheathing. [*Rep. Pat. Inv.*

Patent granted to WILLIAM BATTEN, *county of Kent, for an apparatus for checking, or stopping, Chain Cables, which apparatus may be applied to other purposes. Dated July* 13, 1831.



THE accompanying representation of Mr. Batten's invention is rather intended to convey a rough idea of its mode of operation, (which we could not do satisfactorily in words,) than a correct drawing as to the several proportions and accurate bearings of the machinery, for it was sketched from memory, after an inspection of the original drawing and specification.

The apparatus is intended to be fixed under the hatchway of the deck. The whole to be composed of wrought iron. A, is an iron plate; B, a thick boss of the same, over which the chain, or cable, I, runs; C, a lever playing upon a fulcrum D; E, an eccentric lever, moving upon its fulcrum F, and acting upon the second short lever K. The chain or cable I, is nipped, or stopped, altogether by the extreme ends of each lever being compressed by means of a rope that passes through the pulleys G G. And in order to set the chain or cable free the lever may be retracted by a short rope, H, fastened to the extremity of the lever E.

[*Rep. Pat. Inv.*

On Bridges and Ferries.

A CORRESPONDENT residing in Camden, South Carolina, has called our attention to the subject of bridges and ferries, referring to "the admirable account" of them "as constructed and used across the Rhine, in Dwight's Germany," and adding, that he "cannot but believe, with Mr. Dwight, that they would be worthy of adoption with us, and that the War Department would render service to the community by procuring the estimates of their cost, the detail of their practical value, and the principles on which they are conducted."

We subjoin the following extracts from Dwight's Germany, which, we believe, comprehend all that he has given to us upon the subject.

At page 11, speaking of the river Rhine at Mayence, he observes that it "is here a noble stream, and the only one I have seen in Europe which reminded me of the rivers in the United States. A bridge of boats is thrown across it, on which you pass with as much comfort as over those of stone which arch the Seine. This species of bridge, which I have never seen when travelling in my own country, is so simple, so cheap, and at the same time so convenient, that it is surprising we have never introduced it. It is composed of fifty-six boats well ballasted, that they may not yield too easily to the current, and which are anchored in a straight line, with chain cables. The force of the steam carries them down until they have let out all their length of cable, they are then parallel to each other, their bows being turned to the current. Large beams extend from boat to boat, and across them, at right angles, planks are placed. A bridge is thus formed in a few days. As winter approaches, it is taken to pieces to avoid the floating ice, and on the approaching spring it resumes its place again."

"My desire (he observes at p. 24,) of seeing Frankfort, and the beauty of the Rhine, induced me to return to Mayence. Between Cologne and that city there is but one bridge of boats, at Coblentz. There are, however, several moving bridges resembling our steam ferry boats in their construction, but much superior to them in one respect, that they are always in operation, and with no expense to the proprietor but the wages of the boatmen. A boat is anchored about half a mile above the ferry, in the centre of the stream; to this another is attached by a chain of twenty or thirty feet in length, and to this a third is united, and so on until the last chain reaches the ferry boat. The length of the chain connecting these is continually increasing. The first is anchored very firmly; the others are floating. The force of the current acting on them, and on the large one, is sufficient to carry it from one side to the other. Thus, without fuel or horses, they move from one bank to the other, with almost the same velocity as our team boats, and without any effort but moving the helm."

We have received, since the letter of our correspondent, the March number of the London Journal of Arts and Sciences, containing a communication on "Flying Bridges," which we have transferred to our pages as pertinent to the present subject. The mode of crossing ferries mentioned by Mr. Dwight has been sometimes used in the United States, and that referred to in the London Journal as having been used at Gravesend, in England, was for a considerable period employed on the Hudson river, opposite Troy, in the state of New York, where we have repeatedly crossed by its aid. Like many other old and well known contrivances, a patent was obtained for it, we believe, in the year 1808. Neither the width of the river at Troy, or the constant passing of vessels, admitted of the stretching of a rope above the water, as is practised at some ferries on the continent of Europe; it was allowed therefore to lie on the bottom, as at Gravesend. In order to preserve the proper obliquity of the boat to the current, it was connected to the block which runs upon the crossing

rope, by means of two ropes, one from the stem, and the other from the stern; and by lengthening or shortening one of these, the head was made to point up the stream in crossing in either direction. There was a false keel to the boat, which was a plank of considerable width and made to turn upon a centre pin, so as to be readily shifted, so as to point more up the stream than the boat itself, and it was in fact upon this part that the force of the current was principally exerted.

Various circumstances concurred to induce an eventual abandonment of this mode of crossing. Occasionally, the rope parted and subjected the passengers to delay and inconvenience: this breaking of the rope was sometimes caused by its contact with the keel of one of the numerous vessels ascending and descending that river. Floating ice for a season interfered with its use, whilst the ordinary ferry boats could cross with facility. The tide also rises high enough to produce slack water at Troy, and this consequently interfered with the action of the boat, which is fitted only for places where there is a constant current.

We have said that this plan was patented, but of course, the patent, as such, was worthless. Another patent for a very similar contrivance was obtained by M. D. Brown, of Mason county, Virginia, on the 1st of October, 1830; we do not know, however, that this mode of crossing ferries is now in actual operation in any part of our country. When circumstances admit of their use, we apprehend that the swinging boats, or moving bridges, as they are denominated by Mr. Dwight, would be preferable to the crossing ropes.

We have said more upon this subject than we intended, designing merely to call to it the attention of those who are conversant with the subject; much has been published respecting it, the construction of floating bridges having been treated at length by writers on the military art; and it is well worthy of enquiry to ascertain to what extent, and in what situations, such can be advantageously constructed for general purposes; and also what mode of construction, under all circumstances, is the most eligible. [Editor.

On Flying Bridges.

To the Editor of the London Journal of Arts, &c.

Sir,—Flying bridges are rarely if ever used in this country, because whenever there is any intercourse between the opposite banks of a river, it is generally sufficient to justify the erection of a permanent bridge, and the breadth of our rivers is not in general such as to render the construction of permanent bridges impracticable; moreover, where they are broad, they are seldom rapid enough to prevent a ferry boat from crossing with tolerable ease and expedition.

From their simplicity and cheapness, and the expedition with which they can be constructed, flying bridges are of great use in military operations; they are also very common on the broad and

rapid rivers of the continent, and although little used in England, are not undeserving of attention.

A flying bridge is formed by fastening a floating body to the end of a cable or chain, moored in a river, and keeping the body by a rudder, oblique to the direction of the stream; the action of which against the oblique side of the floating body, drives it away towards one of the banks, moving it in an arc of a circle, about the moorings of the cable.

Fig. 1. *Fig.* 2. *Fig.* 3.

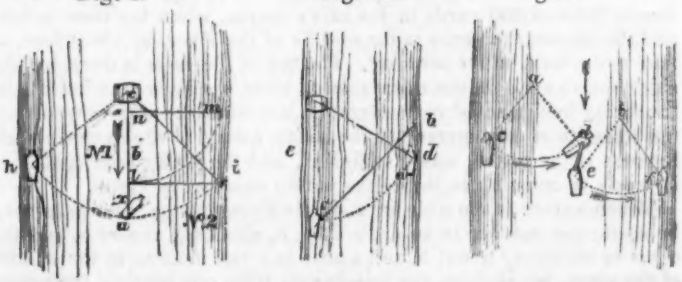


Fig. 1 represents a floating bridge; *a*, a boat fastened by a cable *b* to a buoy, or an anchor, at *c*. The current running in the direction of the arrow No. 1, moves the boat *a*, in an arc of a circle about *c*, away from the bank *h*, towards the bank *i*.

The force which urges the boat *a*, in the direction *h*, *i*, depends upon the obliquity of the boat to the current, and is greatest when the side *x*, makes with it an angle of 54° 44′.*

A bridge of this kind is in use on the Rhine, for crossing opposite Nymuegen. From the bank opposite to Nymuegen, a bridge of boats is built, extending rather more than half across the river. The flying bridge is a platform, or piece of road, laid on a strong barge, to which one end of a chain is made fast; the other end of the chain carried over and fastened to the masts of seven boats, to support its weight, and is moored in the river at some distance up the stream. The barge is steered oblique to the stream, and according to the direction of its obliquity, swings round in an arc of a circle, from the end of the bridge of boats to a jetty on the Nymuegen bank, or *vice versa*. The stream runs about three, to three and a half, miles an hour.

In very rapid rivers, flying bridges should not be made both to cross and recross by the action of the current; for the resistance to the motion of the boat in the ascending part of the arc (viz. in the direction of the arrow, No. 2,) is very great, and the descending force of the stream, to drive the boat down the river, negatives the effect of its oblique action on the boat, to drive it upwards about the moorings of the cable.

In such cases, it is adviseable to make the flying bridge move only one way by the current, viz. in a descending arc, and to haul it back

* Vide Douglas on Military Bridges, p. 94.

by a second cable; thus the boat *a*, fig. 2, crosses to the bank *e*, through a descending arc from the bank *d* to *e*, taking with her a rope *b c*, by which she is hauled back from *e* to the bank *d*.

On the other hand, a flying bridge will not act well in a river with a very slow current at the sides, unless jetties or bridges of boats are built out from the banks, some distance into the river, for the flying bridge to come up to; for when the current at the sides is slight, it will not carry the boat close up to the shore.

A flying bridge was established a few years ago across the *Kistna*, in India: the breadth at the part where the bridge was made is between 700 and 800 yards in the rainy season, when the river is full, and the stream then runs in the middle of the river, at about four, to four and a half, miles per hour. The bed of the river is deep, but the sides shelve up. In the rainy season, when the river was quite full, the flying bridge acted very tolerably, but when the waters were out, the strength of the current at the sides, owing to the extreme shallowness of the water, was insufficient, and the flying boat could not be made to come up to the banks within about forty yards.

When a river is too wide for a simple flying bridge, two boats may be used, one moving in an arc *c d* fig. 3, about the centre *a*, and the other in an arc *e f* about *b*, and a boat or a raft moored in the middle of the river, for shifting the passengers from one boat to the other. Or the raft may be dispensed with, and the cables shifted when the boats come close up to each other; the boat *d* being then made fast to the cable *b e*, and the boat *e* to the cable *a d*, so that each boat will go across in two stages from one bank to the other, through *c d* and *e f*.

Sir H. Douglas recommends this plan, in preference to having a raft in the middle;* we apprehend it might be attended with more danger of the boats fouling and doing injury, if the current were very rapid, for both boats would be moving at their greatest speed, just where they would meet, viz. in the middle of the river; and hence the shock, if by accident they were to strike each other, would be twice as great as the shock of one boat against a stationary raft. Also the difficulty of managing them in a rapid current, to change the cables, would be considerable, and the operation tedious.

We are not aware whether this plan has been extensively adopted in practice. The other is adopted in effect, and answers very well in the Nymuegen flying bridge; for though it has not two boats, the flying boat comes up to the stationary end of the bridge of boats, nearly in the strongest part of the stream.

In flying bridges, the cable should be of a good length, for when it is long, the flying boat moving through the arc of a large circle, has to ascend the stream less than when the cable is short; that is, its direction is nearer to a straight line across the stream, and, consequently, less of the effective force of the current to impel the boat across, is abstracted by the resistance of the current to the ascent of the boat. For instance, in fig. 1, with the cable *c a*, the boat

* See Douglas on Military Bridges.

moves upwards, equal to a distance *a l;* but if the cable were only as long as *c l*, the boat in crossing would move through a distance *l n*, against the stream, which is much greater than *a l.*

The whole motion of the flying boat from side to side, should not exceed a right angle, and then the angle *a c s*, fig. 1, will not exceed 45°; for when the angle *a c s* exceeds 45°, the force *c l* that impels the boat sideways, in opposition to the current, becomes less than the force *l s* which holds it to the centre. This is shown by the triangle *c n m*, fig. 1, where the angle *n c m* is more than 45°. The force *n m* is greater than the force *c n*, and the boat would not, in fact, rise by the oblique action of the stream so far as *m.*

In narrow rivers, not exceeding two hundred yards in width, and with a tolerably rapid current, a flying bridge may be applied with effect, in the following manner:

Let a cable be stretched across the river from bank to bank, and attached on each side to a frame secured in the bank, and drawn tight by a windlass; then attach the flying bridge to this cable, by means of a short rope, with a running block on the cable, and by keeping the boat in an oblique direction to the course of the stream, it will be carried across by the force of the current with considerable effect and expedition. This mode of establishing a flying bridge is more easy of adoption than the former one, and is attended with far less expense and trouble, as the buoys for the support of the cable may be dispensed with, and also the anchor for mooring it in the river.

This plan was used to establish a communication across the Thames at Gravesend, during the threat of invasion from France. The cable was suffered to sink to the bottom, not to interrupt the navigation, and as the boat crossed, the rope rose to the point of suspension on the bank.

The cable should not be sunk when it can be avoided, because the boat has then to move the weight of the rope that connects it to the cable; and, moreover, the running block will run with a great deal more friction upon the wet cable than when it is out of the water.

A triangular raft may be floated over a river, as well as a boat, if it be connected to a warp, or to a moored cable, in any of the ways we have described, by keeping one of its sides oblique to the direction of the stream.

Another mode has been found to answer well, viz. anchor the cable in the middle of the stream, and pass it over a pier of wood or masonry, built in the river, to the flying bridge on the opposite side of the pier. The bridge is then carried across the stream, if kept oblique to it, by the force of the current acting against its side, without the necessity of using buoys or boats for supporting the cable, which, at all times, tend greatly to impede the motion of the bridge, because the current acts upon them in an opposite direction to that in which it affects the flying bridge itself, and the latter has therefore, in effect, to drag the buoys through the water, against a considerable resistance.

When a river exceeds two hundred yards in width, it is necessary

to adopt the mode of mooring the end of the cable in the stream, and passing it over buoys, or a pier to support its weight; but where a river is less than two hundred yards wide, the system of causing the flying bridge to traverse the river on a cable stretched across it from bank to bank, may be considered as far preferable in every respect.

P.

Prevention of Falsification of Written Instruments.

The attention of the French government has long been directed to the possibility of finding some means of preventing writing being chemically discharged from papers and other documents, either for the purpose of falsifying the contents, or for making a second and fraudulent use of old stamps. With this view the Academy of Sciences was directed to take the subject into consideration, and a committee, consisting of MM. Gay Lussac, Dulong, Chaptal, Deyeux, Thenard, D'Arcet, Chevreuil, and Serullas, was appointed for the purpose. The attention of the public was called to the subject, and a great number of specimens of ink, alleged to be indelible, were forwarded to the committee. Numerous experiments were made, and on the 30th of May, and 6th of June, the report was read to the Academy by M. D'Arcet. It is unnecessary for our purpose to follow the reporter through his elaborate history of the different manufactures of ink in different ages, or the detail of the experiments made with the various samples submitted to the committee; it is sufficient to state the conclusions which were unanimously adopted as the results of the investigation. These were, that the falsification of written documents will be fully prevented by the use of ink prepared in either of the two following manners: 1. Indian ink, (or in its absence the imitation of it made in Europe with soot and animal glue or gum) dissolved in a mixture of water and muriatic acid, of the specific gravity of 1010, (1¾ degrees of Beaumé's instrument.) This ink may be prepared for four pence English per quart. 2. To a solution of acetate of manganese, of the specific gravity of 1074, (10 degrees of Beaumé,) add half its volume of solution of carbonate of soda crystallized, saturating it at about 166 per cent.: dissolve India ink in this liquid, and writing traced with it will become perfectly indelible on being exposed to the action of the vapour of liquid ammonia. The committee lay down, as a general principle, that no ink, kept in a liquid state, can be indelible, as the colouring matter, from its excess of density, will necessarily be deposited. Additional security will be obtained by writing on paper so prepared, that even if the ink could be discharged, it would necessarily be seen that it had been so discharged. Thus, M. Coulier proposes a paper, having printed on each sheet, lines and patterns, so complicated, as to defy forgery, and struck off from a steel plate damasked with aquafortis. The ink with which this is printed would be discharged by chlorine, so that the superjacent writing cannot be destroyed without also destroying the drawing. The plan is excellent for bills of exchange

and other small documents; but from the expense and delay occasioned by the engraving and printing, the designs would be ill adapted for legal proceedings and public documents. M. Chevallier proposes a paper coloured in the pulp with colours liable to be discharged by all the known re-agents, but this might easily be recoloured when the alteration is made. M. Maimu suggests adding to the pulp of the paper filaments of wool, cotton, or hemp, dyed of different colours, some of which will be acted on by the acids, and others by the alkalies, but all liable to be discharged by chlorine. When these colours are discharged, it is almost impossible to restore them; but the writing may, in some cases, be effaced without any sensible alteration in the colour of the filaments; and on the other hand that colour will frequently change by simple exposure to the air, without any re-action being used. Mr. Coulier's method is by far the best, but has the disadvantage, that all designs easily dischargeable from the papers may become injured by time or accidental circumstances; a consideration which, in cases of forgery, would tend to render probable the impunity of the guilty by the fear which would be entertained of condemning the innocent. The use of these prepared papers must therefore be considered as very secondary, the main security must be found in the indelible inks. The discharge of the writing from old stamped documents, and the consequent fradulent use of the stamp, may be prevented. 1st. By printing on all stamped paper, by means of a cylindrical press, an engine-turned vignette, placed on the right of the stamp, in the centre, and along the whole length of each sheet. 2nd. By employing, in printing these vignettes, a colour having for its base the black precipitate formed in the dying coppers of hatters, or ink thickened in the manner adopted in the manufactories of painted cloths. And 3d. By marking on all stamped papers, the date of their fabrication, either by printing it in the pulp, or engraving it on the vignette or the stamp; or, more simply still, by making the dry stamp, impressed on each sheet of paper, revolve, so as to affix a new date each year. This report was ordered to be transmitted to the Minister of Justice.

[*Jour. Royal Ins.*

Blue extracted from the Stalk of Buck-Wheat.
(*Polygonum fagopyrum.*)

A BLUE colour, serviceable for dying, may be extracted from buck-wheat, in the following manner:

The stalks are cut before the grain has become mature; they are spread out upon the earth, exposed to the sun, and suffered to remain till the grain separate with facility. When this has been effected, the straw is collected, wetted, and allowed to ferment until decomposition take place, and the heap have assumed a blue appearance. It is then formed into balls, or cakes, and dried by the sun, or in a stove. These masses being boiled in water will impregnate it with a deep blue, which neither vinegar nor sulphuric acid

will discharge. Alkalis will change it to a red; the powder of nut-galls reduce it to a perfect black; and, by evaporation, it will become a beautiful green. Stuffs dyed with this preparation, and by the usual method, take the dies from other vegetable substances; the blue is very beautiful, and the colour stands well.

[*Jour. Etrangers.*

Transport of Edifices.

On the 2nd of May, M. Gregori alluded to a circumstance mentioned in a late number of the Journal des Artistes, of a rock of granite, forty-two feet long and twenty-seven high, having been transported from the bay of Finland to St. Petersburg, to serve as a pedestal to a statue of Peter the Great. He stated that a much more remarkable fact had occurred at Crescentio, in 1776, when a common mason, named Serra, succeeded in transporting a brick belfry, which he had contrived to cut from its base without injuring the walls, from one church to another, at a considerable distance. While it was being moved, a man inside rang the bells. A model of the machine employed in the transport, was deposited in the library of the institute.

[*Proceed. of Roy. Acad. of Sci. of Paris.*

Protoxide of Copper.

The simplest and easiest method of obtaining protoxide of copper is the following:—Dissolve the copper in muriatic acid, to which small portions of nitric acid are to be added; afterwards evaporate to dryness, and heat the chloride obtained to its fusing point. It is thus converted into brown crystallized chloride. It is afterwards to be fused, ten parts with six of dry carbonate of soda, in a covered crucible, at a low red heat. The mass is to be treated with water, to dissolve the common salt formed; the protoxide of copper separates in the state of an uncrystalline powder of a fine red colour, which is to be washed and dried.

If muriate of ammonia be added to the above mixture, all the chloride is reduced, as will readily be foreseen, to metallic copper, which separates in a very divided and spongy state, when the mass is dissolved in water. [*Phil. Mag.*

Means of preventing Incrustations in Steam Boilers.

M. Ferrari has announced to the Royal Academy of Sciences of Turin, that he has observed that charcoal in coarse powder prevented incrustations from forming in the boilers of steam engines, and detached them when they have already formed.

[*Jour. de Chimie Médicale.*

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